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# Fur Seal Investigations, 1967

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UNITED STATES DEPARTMENT OF THE INTERIOR
U.S. FISH AND WILDLIFE SERVICE
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# Fur Seal Investigations, 1967

by

MARINE MAMMAL BIOLOGICAL LABORATORY

U.S. Fish and Wildlife Service
Special Scientific Report--Fisheries No. 597

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# Fur Seal Investigations, 1967

by

Bureau of Commercial Fisheries
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## ABSTRACT

Totals of 55,720 male northern fur seals (Callorhinus ursinus) and 10,471 females were killed on the Pribilof Islands in 1967. The predicted kill of males was 56,200. Counts of dead seals on the rookeries included 17,426 pups, 155 adult males, and 185 adult females. Counts of live adult males were 8,876 harem and 5,707 idle.

Major causes of death among 232 pups were malnutrition, liver damage-multiple hemorrhage-perinatal complex, hookworm disease, and infections.

Thirty-four percent of 1,255 females age 4 and older had given birth to pups.

The mean weights of pups from four rookeries differed significantly.

Seals tagged included 12,472 pups, 835 yearlings, and 1,200 of ages 2 to 4; 115 pups were marked by freeze branding. A total of 5,435 seals tagged on the Pribilof Islands were recovered there in 1967 as were 31 seals tagged by the U.S.S.R. on the Commander Islands or on Robben Island.

An estimated 377,000 pups were born on the Pribilof Islands in 1965 and 385,000 in 1967. The estimate of yearling males in 1963 from the 1962 year class was 79,000; in 1965 the estimate of yearlings from the 1964 year class was 129,000. The predicted kill of 2- to 5-year-old males on the Pribilof Islands in 1968 is 49,500.

An artificial formula supplemented with selenium, vitamin E, methionine, and glycerin, was superior to an unsupplemented formula for maintaining fur seal pups in captivity.

During pelagic fur seal investigations, seals were most commonly seen within 111 km. (60 nautical miles) of land in January and February, and most were collected off Cape Flattery and westward to La Perouse Bank. Of 835 fur seals sighted off Washington, 131 were collected 27 were wounded and lost, and 21 were killed and lost. Of 118 female seals collected, 57 percent were gravid; the youngest were three primiparous and one multiparous 5-year-olds.

Salmonidae (Oncorhynchus spp.) and Pacific herring (Clupea harengus pallasi) were the principal species eaten by seals off Washington. Shrimp were found for the first time in fur seal stomachs.

We saw 32 seals and collected 1 during studies of distribution in the Bering Sea and in waters near the eastern Aleutian Islands from 20 November to 4 December 1966.

One of us observed Japanese pelagic fur seal research in April and May 1967.

We saw two fur seals off northern California in September and none off Washington and Oregon in August and September 1967.

On the basis of gastrointestinal contents and parasites, 9 of 20 pups had fed on marine organisms while still on the Pribilof Islands.

## INTRODUCTION

The problems of managing an international resource have collectively been the strongest influence in establishing and maintaining a sustained research program for the northern fur seal (Callorhinus ursinus). Investigations intended to supply information needed by the North Pacific Fur Seal Commission for management of fur seals have continued since 1956 on the Pribilof Islands and since 1958 at sea.

With international cooperation the northern fur seal population lends itself far better than most other animal populations to studies of population dynamics and to management. The continuing investigations have provided much of the information needed to manipulate the seal population. Much less progress has been made on the more difficult problem of understanding the relationship of factors affecting the population and the effect of population density.

This report describes research done by the United States in 1967 on land and at sea, as approved by the North Pacific Fur Seal Commission at its 10th annual meeting in February 1967.

Part I, on land investigations, was contributed by the following: Raymond E. Anas, Douglas G. Chapman (Laboratory of Statistical Research, University of Washington), Ancel M. Johnson, Mark C. Keyes, Alton Y. Roppel, and Ford Wilke.

Part II, on pelagic investigations, is a summary of work done by Clifford H. Fiscus, Hiroshi Kajimura, and Richard K. Stroud.

# Part I. FUR SEAL INVESTIGATIONS, PRIBILOF ISLANDS, ALASKA

The objectives of fur seal research on the Pribilof Islands are to (1) collect the data needed to determine the reaction of the herd to an artificially low population level created to provide a basis for determining the level of maximum sustained yield, (2) determine the causes of mortality, and (3) find a way to accurately predict survival of the young to ages 3 and 4. This report summarizes the information collected in 1967 and describes the progress made toward the achievement of these objectives.

Terms having special meanings in fur seal research are described in the Glossary. Figures 1 and 2 show the location of rookeries and hauling grounds on St. Paul and St. George Islands.

## AGE CLASSIFICATION AND NUMBER OF SEALS KILLED, BY SEX

The kill of seals on St. Paul and St. George Islands in 1967 was 54,891 males (ages 2 to 6) and 10,096 females (age 2 and older).

### MALES

A kill of 54,891 males in ages 2 to 6 included 42,359 taken on St. Paul Island and 12,532 taken on St. George Island (tables A-1 to A-4). An additional 829 young males of unknown ages were inadvertently taken during the kill of females 7-17 August.

The kill of males in 1967 was adjusted according to methods described previously (U. S. Fish and Wildlife Service, Bureau of Commercial Fisheries, 1969) to show the magnitude of possible error in determining ages from canine teeth (table 1). We did not use the corrected ages in calculations involving the age classification of the kill in 1967 because we have not tested possible errors in determining ages both between days within years and between years. In any case, errors in determining age are small and would have little effect on the numbers of seals in each age except for those taken at age 2.

All available subadult males 107 cm. (42 inches) long or longer from tip of nose to tip of tail, but without manes, were taken. Three-year-olds dominated the kill throughout the season on St. Paul Island (fig. 3) and after 6 July on St. George Island (fig. 4). Efforts were continued to increase the utilization of males by killing as many as practical of the large 4-year-olds and by using firecrackers to frighten seals away from inaccessible reefs and from under cliffs.

The lower length limit of 107 cm. (42 inches) was removed on St. Paul Island during the kill on Northeast Point Rookery 22 July and on Zapadni Rookery 24 July so that all available 2-year-old males could be killed for our study of the relation of abundance on land at age 2 to the number available for killing at age 3. We determined age and body length for 20 percent of all males killed on these 2 days.

Male seals were killed Monday through Saturday of each week on St. Paul Island, and on Mondays, Wednesdays, and Fridays on St.

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Table 1.--Unadjusted and adjusted kill of male seals, Pribilof Islands, Alaska, 1967

| Age | Unadjusted kill | Adjusted kill | Difference |
|---|---|---|---|
| | Number | Number | Number |
| 2 | 2,940 | 2,473 | + 18.89 |
| 3 | 34,613 | 35,263 | - 1.84 |
| 4 | 15,523 | 15,366 | + 1.02 |
| 5 | 1,679 | 1,653 | + 1.57 |
| Total | 54,755 | 54,755 | |

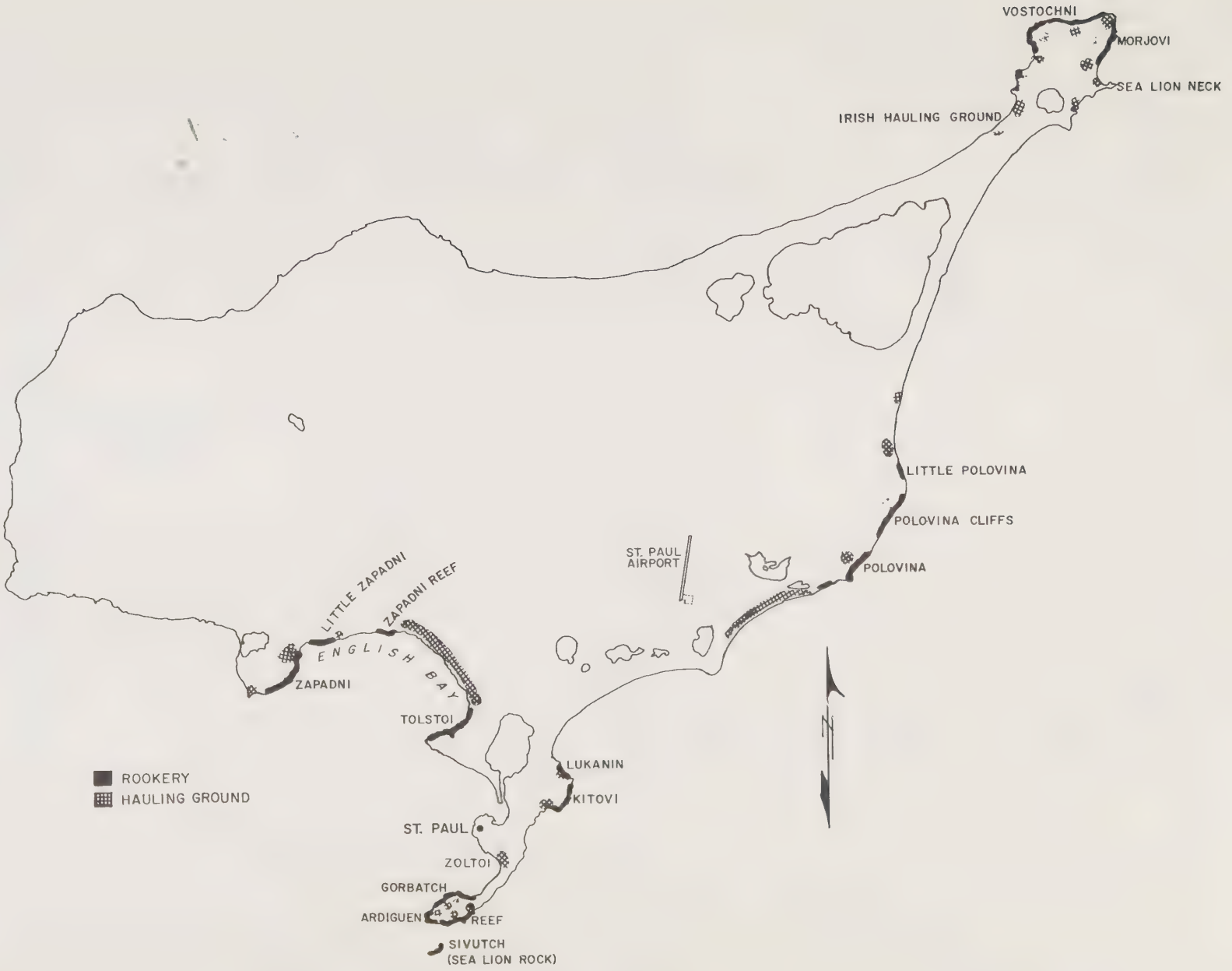



Figure 1.--Location of rookeries and hauling grounds, St. Paul Island.

Figure 2.--Location of rookeries and hauling grounds, St. George Island.

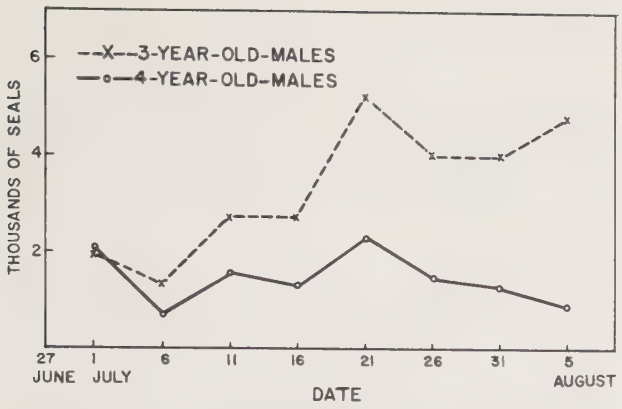



Figure 3.--Kill of 3- and 4-year-old male seals, by 5-day periods, St. Paul Island, 27 June to 5 August 1967.

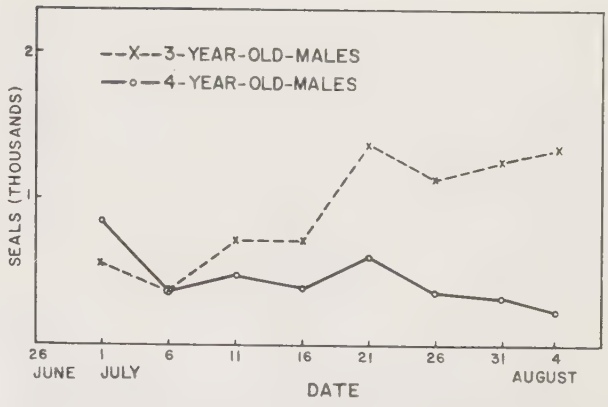



Figure 4.--Kill of 3- and 4-year-old male seals, by 5-day periods, St. George Island, 26 June to 4 August 1967.

Table 2.--Kill of male seals, 1/ by year class, Pribilof Islands, Alaska, 1947-65

| Year class | St. Paul Island | | | | | St. George Island | | | | | Grand total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Age when killed | | | | | Age when killed | | | | | |
| | 2 | 3 | 4 | 5 | Total | 2 | 3 | 4 | 5 | Total | |
| | Number | | | | | Number | | | | | |
| 1947 | - | 30,110 | 23,697 | 854 | 54,661 | - | 7,043 | 3,731 | 123 | 10,897 | 65,558 |
| 1948 | 486 | 25,714 | 19,995 | 103 | 46,298 | 114 | 5,546 | 3,926 | 22 | 9,608 | 55,906 |
| 1949 | - | 29,697 | 12,326 | 249 | 42,272 | 303 | 7,116 | 2,570 | 280 | 10,269 | 52,541 |
| 1950 | 855 | 40,656 | 15,365 | 332 | 57,208 | 1,104 | 8,475 | 4,793 | 147 | 14,519 | 71,727 |
| 1951 | 1,384 | 32,350 | 18,083 | 3,057 | 54,874 | 288 | 7,907 | 5,310 | 681 | 14,186 | 69,060 |
| 1952 | 1,735 | 30,733 | 31,410 | 675 | 64,553 | 545 | 8,998 | 8,459 | 506 | 18,508 | 83,061 |
| 1953 | 839 | 38,312 | 8,855 | 54 | 48,060 | 295 | 10,611 | 3,330 | 100 | 14,336 | 62,396 |
| 1954 | 2,918 | 23,473 | 5,599 | 554 | 32,544 | 535 | 6,651 | 2,779 | 162 | 10,127 | 42,671 |
| 1955 | 1,015 | 27,863 | 10,555 | 115 | 39,548 | 555 | 7,246 | 2,825 | 260 | 10,886 | 50,434 |
| 1956 | 885 | 10,671 | 2,762 | 532 | 14,850 | 171 | 2,251 | 1,387 | 218 | 4,027 | 18,877 |
| 1957 | 2,590 | 24,283 | 15,344 | 773 | 42,990 | 242 | 5,098 | 4,492 | 244 | 10,076 | 53,066 |
| 1958 | 1,977 | 48,458 | 14,149 | 1,587 | 66,171 | 431 | 9,413 | 3,707 | 540 | 14,091 | 80,262 |
| 1959 | 2,820 | 26,456 | 14,184 | 1,764 | 45,224 | 891 | 5,890 | 4,690 | 492 | 11,963 | 57,187 |
| 1960 | 1,619 | 14,310 | 10,533 | 1,240 | 27,702 | 636 | 4,332 | 2,579 | 178 | 7,725 | 35,427 |
| 1961 | 1,098 | 22,468 | 12,046 | 1,270 | 36,882 | 921 | 6,948 | 2,592 | 502 | 10,963 | 47,845 |
| 1962 | 2,539 | 19,009 | 12,156 | 1,287 | 34,991 | 1,139 | 3,736 | 3,881 | 392 | 9,148 | 44,139 |
| 1963 2/ | 1,264 | 25,535 | 11,785 | - | 38,584 | 167 | 5,586 | 3,738 | - | 9,491 | 48,075 |
| 1964 2/ | 3,143 | 26,991 | - | - | 30,134 | 391 | 7,622 | - | - | 8,013 | 38,147 |
| 1965 2/ | 2,200 | - | - | - | 2,200 | 740 | - | - | - | 740 | 2,940 |
| Mean | 1,727 | 27,616 | 14,050 | 903 | 3/ 43,707 | 526 | 6,693 | 3,811 | 303 | 4/ 11,362 | 3/ 55,147 |

1/ Includes only 2- to 5-year-old seals taken during the kill of males on the Pribilof Islands. From 1956 to 1965, 131 1-year-olds and 493 6-year-olds were taken on St. Paul Island and 20 1-year-olds and 164 6-year-olds were taken on St. George Island. In addition, age was not determined for 3,862 males taken on St. Paul Island, and 1,246 taken on St. George Island.

2/ Incomplete returns.

3/ 1947, 1949, 1963, 1964, and 1965 year classes not included.

4/ 1947, 1963, 1964, and 1965 year classes not included.

George Island. Killing began about 6 a.m. each day on St. Paul Island and about 9 a.m. on St. George Island. We determined the age composition of the kill from collections of right upper canine teeth from 20 percent of the males killed each day.

Table 2 gives the kills of male seals on the Pribilof Islands from year classes 1947-65.

## FEMALES

A total of 10,096 female seals were killed on the Pribilof Islands in 1967 as excess to the number needed to maintain the population at the present level. Of 7,502 females killed on St. Paul Island, 2,724 were taken during the kill of males from 27 June to 5 August, and 4,778 were killed 8-15 August. On St. George Island, 202 females were killed from 26 June to 4 August, and 2,392 were taken 7-17 August. The kill began about 9 a.m. each day on both islands.

We calculated the age composition of the kills from right upper canine teeth collected from 30 percent of the females taken (tables A-5 to A-8).

All females driven were killed regardless of age or size. The kill on St. Paul Island was restricted to animals on the hauling ground. On St. George Island, females were taken from hauling grounds and from rookery fringes.

Table 3 shows the kills of females from year classes 1943-66.

Table 3.--Kill of female seals on the Pribilof Islands, Alaska, and at sea[1] from year classes 1943-66

| Year class | Age in years | | | | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| | Number | | | | | |
| 1943 | - | - | - | - | - | 12 |
| 1944 | - | - | - | - | 3 | 11 |
| 1945 | - | - | - | 4 | 4 | 8 |
| 1946 | - | - | - | 4 | 4 | 60 |
| 1947 | - | 1 | - | 1 | 37 | 84 |
| 1948 | - | - | - | 84 | 75 | 94 |
| 1949 | - | - | 30 | 34 | 161 | 118 |
| 1950 | - | 10 | 17 | 92 | 210 | 2,949 |
| 1951 | 4 | - | 8 | 85 | 4,618 | 6,343 |
| 1952 | - | - | 16 | 6,422 | 11,465 | 3,408 |
| 1953 | - | 1 | 2,132 | 5,806 | 4,056 | 2,958 |
| 1954 | - | 132 | 1,150 | 8,493 | 3,771 | 683 |
| 1955 | - | 11 | 11,468 | 7,285 | 1,047 | 4,810 |
| 1956 | - | 601 | 2,072 | 614 | 4,520 | 3,444 |
| 1957 | 150 | 281 | 352 | 6,912 | 6,303 | 4,080 |
| 1958 | 76 | 79 | 4,651 | 8,683 | 8,697 | 1,914 |
| 1959 | 27 | 508 | 4,563 | 8,044 | 3,626 | 621 |
| 1960 | 120 | 431 | 2,979 | 3,409 | 1,121 | 46 |
| 1961 | 37 | 724 | 3,434 | 2,629 | 85 | 1,193 |
| 1962 | 7 | 390 | 1,384 | 93 | 1,571 | |
| 1963 | 26 | 172 | 45 | 1,597 | | |
| 1964 | 12 | 13 | 963 | | | |
| 1965 | 58 | 33 | | | | |
| 1966 | 10 | | | | | |

[1] Female seals taken at sea were part of the pelagic research kill of the United States and Canada during the calendar years 1958-67. Not included in the table are 131,628 female seals classified as age 7 and older and 7,029 female seals killed on the Pribilof Islands from the indicated year classes.

## SURVEY DATA

Data collected in 1967 to follow the response of the population to changes in its size included: (1) Counts of dead pups and adults; (2) counts of living adult males; (3) major causes of mortality of pups; (4) reproductive condition of females; and (5) weights of live pups.

## MORTALITY

This section includes data on pups that died on the Pribilof Islands during most years since 1941, and adults that died on St. Paul Island in 1965-67 and on St. George Island in 1966-67.

### Pups

Biologists have counted dead pups on the Pribilof Islands about mid-August nearly every year since 1948 (table A-9). In 1966 and 1967 we also recorded the number of pups that died within sections established on each of the St. Paul Island rookeries. Table A-10 shows the counts obtained by section in 1967.

In 1967 we recorded the causes of death among pups on three rookery areas selected for sampling.

Counts of dead pups.--The count of dead pups on the Pribilof Islands in 1967 was 17,426; 14,780 were on St. Paul Island and 2,646 were on St. George Island (table A-9).

Causes of pup mortality.--From 29 June to 15 August, 232 dead pups were necropsied. The pups were gaffed from catwalks in two areas on Reef Rookery and one on Northeast Point Rookery (figs. 5 and 6). Collections from the two rookeries were alternated daily. Table 4 gives the distribution of the five primary causes of death, of the miscellaneous causes, and of the undetermined causes.

1. Malnutrition. Mortality from malnutrition on area 1, though of about the same magnitude as in 1966 (table 5), was about 15 percent higher than the average loss from this cause on areas 2 and 3 (table 4).

2. Liver damage-multiple hemorrhage-perinatal complex. This condition is characterized by one or all of the following lesions: interruption of the liver capsule and corresponding separation of the liver parenchyma; subcapsular hemorrhage of the liver causing separation of capsule and parenchyma to form blood blisters 3 to 50 mm. in diameter; foci of hepatic necrosis which form stellate areas of increasing size as the post mortem period lengthens; subpleural hemorrhage of other organs such as the lung and kidney; free blood in the anterior chamber of both eyes; and free blood in the peritoneal cavity. The condition is perinatal; it is usually found in pups with attached placentas or fresh umbilical cords, and frequently in stillborn pups. Thirty-eight percent of pups with rupture of the liver showed no evidence of bite wounds or contusions.

We believed that the total of 11 dead (4 percent) among 273 pups in 1964 and 1966 was caused by simple trauma (physical injuries). The 40 cases from 232 dead pups in 1967 is a fourfold increase. The multiple necrotic foci and subcapsular hemorrhages observed on 12.5 and 22.5 percent, respectively, of the livers of these 40 pups, are lesions we have never seen in fur seals before. One of the most striking features revealed by post mortem examinations

Figure 5.--Pup mortality, study areas 1 and 2, Reef Rookery, St. Paul Island, mid-July 1967.

Figure 6.--Pup mortality, study area 3, Northeast Point Rookery, St. Paul Island, mid-July 1967.

Table 4. --Primary causes of death among pups, three mortality study areas, St. Paul Island, 29 June to 15 August 1967

| Causes of death | Study areas | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Reef Rookery | | | | Northeast Point | | | |
| | Area 1 Old catwalk | | Area 2 New catwalk | | Area 3 Hutchinson Hill | | | |
| | Dead pups | | Dead pups | | Dead pups | | Total | |
| | Number | Percent | Number | Percent | Number | Percent | Number | Percent |
| Malnutrition | 32 | 40.0 | 13 | 24.1 | 27 | 27.5 | 72 | 31.0 |
| Liver damage-multiple hemorrhage-perinatal complex | 10 | 12.5 | 10 | 18.5 | 13 | 13.3 | 33 | 14.2 |
| Hookworm disease | 4 | 5.0 | 1 | 1.9 | 32 | 32.7 | 37 | 16.0 |
| Infection | 6 | 7.5 | 5 | 9.3 | 9 | 9.2 | 20 | 8.6 |
| Navel | (3) | (3.8) | (1) | (1.9) | (1) | (1.0) | ( 5) | (2.2) |
| Peritonitis | (1) | (1.2) | (0) | (0.0) | (2) | (2.0) | ( 3) | (1.2) |
| Pleuritis | (1) | (1.2) | (1) | (1.9) | (3) | (3.1) | ( 5) | (2.2) |
| Enteritis | (1) | (1.2) | (1) | (1.9) | (3) | (3.1) | ( 5) | (2.2) |
| Cellulitis | (0) | (0.0) | (1) | (1.9) | (0) | (0.0) | ( 1) | (0.4) |
| Abscess | (0) | (0.0) | (1) | (1.9) | (0) | (0.0) | ( 1) | (0.4) |
| Trauma | 6 | 7.5 | 4 | 7.3 | 6 | 6.1 | 16 | 6.9 |
| Bite wounds | (3) | (3.8) | (4) | (7.3) | (4) | (4.1) | (11) | (4.7) |
| Skull fracture | (1) | (1.2) | (0) | (0.0) | (1) | (1.0) | ( 2) | (0.8) |
| Contusion | (2) | (2.5) | (0) | (0.0) | (1) | (1.0) | ( 3) | (1.2) |
| Miscellaneous | 4 | 5.0 | 5 | 9.3 | 6 | 6.1 | 15 | 6.5 |
| Stillborn | (1) | (1.2) | (1) | (1.9) | (4) | (4.1) | ( 6) | (2.6) |
| Nonhookworm anemia | (2) | (2.5) | (1) | (1.9) | (1) | (1.0) | ( 4) | (1.8) |
| Meconium impaction | (0) | (0.0) | (1) | (1.9) | (0) | (0.0) | ( 1) | (0.4) |
| Hernia (and eventration) | (0) | (0.0) | (1) | (1.9) | (0) | (0.0) | ( 1) | (0.4) |
| Premature | (1) | (1.2) | (0) | (0.0) | (0) | (0.0) | ( 1) | (0.4) |
| Hydrocephalus | (0) | (0.0) | (1) | (1.9) | (0) | (0.0) | ( 1) | (0.4) |
| Milk inhalation | (0) | (0.0) | (0) | (0.0) | (1) | (1.0) | ( 1) | (0.4) |
| Undetermined | 8 | 10.0 | 6 | 11.1 | 3 | 3.1 | 17 | 7.3 |
| Unsuitable for examination | 10 | 12.5 | 10 | 18.5 | 2 | 2.0 | 22 | 9.5 |
| Totals | 80 | 100.0 | 54 | 100.0 | 98 | 100.0 | 232 | 100.0 |

Table 5.--Causes of pup mortality on study area 1, Reef Rookery, St. Paul Island, 28 June to 15 August 1966 and 1967

| Primary cause of death | 1966 | 1967 | 1966 | 1967 |
|---|---|---|---|---|
| | Number | | Percent | |
| Malnutrition | 67 | 32 | 44.1 | 40.0 |
| Liver damage-multiple hemorrhage-perinatal complex | 4 | 10 | 2.6 | 12.5 |
| Hookworm disease | 24 | 4 | 15.8 | 5.0 |
| Trauma | 18 | 6 | 11.8 | 7.5 |
| Infection | 15 | 6 | 9.9 | 7.5 |
| Miscellaneous | 4 | 4 | 2.6 | 5.0 |
| Undetermined | 10 | 8 | 6.6 | 10.0 |
| Subtotal | 142 | 70 | 93.4 | 87.5 |
| Unsuitable for examination | 10 | 10 | 6.6 | 12.5 |
| Total | 152 | 80 | 100.0 | 100.0 |

on fur seals since 1962 has been a lack of lesions in the liver. The associated bilateral ocular hemorrhage (20 percent of the cases) is also new in fur seal pathology. Simple trauma does not account for the sudden increase in the number of cases and the unique syndrome associated with this disease. The likelihood of a predisposition to liver rupture and hemorrhage seems strong. Microbiological and histological studies of liver and other tissues are underway.

This disease of fur seals may be new but is more likely a sudden increase in a condition that occurred at such a low level in the past that it was not recognized. There was not sufficient opportunity for recognition because early pup mortality from late June to mid-July has been studied in only 3 years--1958, 1966, and 1967.[1]

Table A-11 shows the lesions and circumstances associated with the cases observed in 1964, 1966, and 1967.[2]

3. Hookworm disease. Investigators have long believed, without quantitative evidence, that the death rate from hookworm disease varied from rookery to rookery. Table 4 shows a striking difference between area 3, with a death rate of 32.7 percent from hookworm disease, and areas 1 and 2, with rates of 5.0 and 1.9 percent. We cannot explain this variation. The death rate from hookworm disease on area 1 was 8.1 percent in 1964, 17.7 percent in 1966, and 5.0 percent in 1967.[2]

4. Enteritis. In previous years necrohemorrhagic enteritis has been seen mostly as a terminal condition in emaciated pups; there were 27 such cases in 1967. We assumed that enteritis developed as a result of gut stasis and lower resistance to infection brought about by malnutrition. In most cases this explanation is still the most logical; however, in 1967 enteritis was the only important lesion in four pups whose body condition was otherwise good. One other pup, with severe enteritis, had a generalized systemic infection. We isolated two species of bacteria, Proteus mirabilis and Escherichia coli, from the small intestines of this pup and two of the other four cases of enteritis. The same organisms were isolated from one of several artifically reared pups that had died of enteritis. Proteus mirabilis had been isolated from captive pups,[3] from a rookery pup that died of malnutrition and secondary necrohemorrhagic enteritis (Keyes, 1965), and from flipper abscesses of a rookery pup (U.S. Fish and Wildlife Service, Bureau of Commercial Fisheries, 1969). The Proteus organism had not been isolated previously from cases in which enteritis, or complications of an enteric infection, was a primary cause of death.

5. Stillbirths. Of the 232 pups examined, 17, or 7.3 percent, were stillborn (had never breathed). Eleven of these were included among those classified as liver damage-multiple hemorrhage-perinatal complex. An occasional pup drowns in embryonal fluid when the fetal membranes over the head fail to break. In other cases, the pups are dead before parturition.

6. Undetermined causes and pups unsuitable for examination. In 1967, we picked up dead pups for autopsy every 2d or 3d day instead of daily, as in 1964 and 1966. The percentage of pups classified as unsuitable for determining cause of death in 1967 was nearly double that of 1966 (table 5); 26 percent of the 232 pups examined had advanced post mortem degeneration (table A-12).

Seasonal and annual trends in pup mortality.--Figure 7 compares total numbers of pup deaths throughout each season in 1964, 1966, and 1967. Peaks of mortality occurred at about the same time in each of the 3 years. The peaks coincide with the peak of births, the early deaths from injury, and the lag necessary for deaths from malnutrition, hookworm disease, and infection to occur (table A-12).

[1] Studies of pup mortality in 1964 were begun on 9 July.

[2] Includes deaths to 22 August in 1964 and 1966, and to 15 August in 1967.

[3] Mark C. Keyes. 1964. Research in fur seal mortality, St. Paul Island, Alaska, 8 July to 24 September 1963. Bureau of Commercial Fisheries Marine Mammal Biological Laboratory, Seattle, Wash. [Processed, 140 pp.]

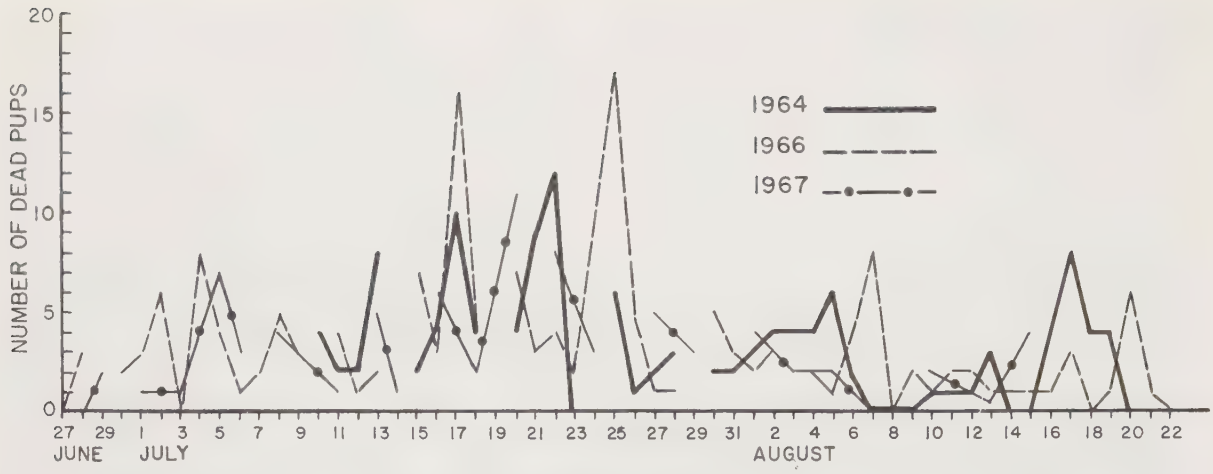



Figure 7.--Pup mortality, study area 1, Reef Rookery, St. Paul Island, 1964, 1966, and 1967.

The number of pups that died on area 1 of Reef Rookery in 1964-67 is compared in table 6 with the total number of dead pups counted on Reef Rookery and on St. Paul Island during the same period. If we assume the population of pups during this period has been constant at 280,000 [based on shearing and sampling--see U.S. Fish and Wildlife Service, Bureau of Commercial Fisheries (1969, table 19)] the annual mortality for St. Paul Island was 7.7 percent in 1964, 14.0 in 1965, 7.6 in 1966, and 5.3 percent in 1967.

Table 6.--Mortality of pups on study area 1 of Reef Rookery, on Reef Rookery, and on St. Paul Island, 1964-67

| | Year classes | | | |
|---|---|---|---|---|
| | 1964 | 1965 | 1966 | 1967 |
| | ---------- Number ---------- | | | |
| Dead pups cleared from area 1..... | 161 | 337 | 164 | 80 |
| Dead pups counted on Reef Rookery..... | 3,000 | 7,664 | 3,562 | 2,008 |
| Dead pups counted on St. Paul Island..... | 21,572 | 39,124 | 21,414 | 14,780 |

## Adults

Table 7 shows the numbers of dead adult males and females counted on the Pribilof Islands in 1965-67.

Table 7.--Counts of dead adult male and female seals, Pribilof Islands, Alaska, 1965-67

| Year | St. Paul Island | | St. George Island | | Total | |
|---|---|---|---|---|---|---|
| | Males | Females | Males | Females | Males | Females |
| | ---------- Number ---------- | | | | | |
| 1965 | 158 | No count | No count | No count | 158 | No count |
| 1966 | 181 | 172 | 41 | 55 | 222 | 227 |
| 1967 | 108 | 157 | 41 | 28 | 149 | 185 |

## COUNTS ON LIVING ADULT MALE SEALS

Adult males approximately age 7 and older have been counted on the Pribilof Islands in mid-July nearly every year since 1911 and classified as harem (with one or more females) or idle (without females) (table A-13). The counts on St. Paul Island in 1967 were obtained on Reef, Lukanin, Kitovi, Tolstoi, and Zapadni Reef Rookeries only, then extrapolated to produce an estimate representing all the rookeries. On the basis of proportional change observed on the five sample rookeries between 1966 and 1967, the estimated totals for St. Paul Island in 1967 were 7,230 harem and 4,439 idle males--a reduction from 1966 of 9 percent in harem males and 24 percent in idle males.

Since 1966, adult males have been classified as shoreline (class 1), territorial without females (class 2), territorial with one or more females (class 3), back fringe (class 4), or hauling ground (class 5). Class 3 males were formerly classified as harem males; classes 1, 2, 4, and 5 were counted as idle males.

In 1967, we counted the five classes of adult males on St. Paul Island on all rookeries in June (table A-14) and on Reef, Lukanin, Kitovi, Tolstoi, and Zapadni Reef Rookeries in July (table A-15). We kept records of the number of adult males of each class counted within sections established on the rookeries in 1966.

We counted the five classes of adult males on St. George Island on all rookeries in June and July 1967 (table A-16).

## REPRODUCTIVE CONDITION OF FEMALE SEALS

We examined the genital tracts and ovaries of 1,362 females killed 1-15 August on St. Paul Island for evidence of parturition in 1967. The

Table 8.--Reproductive condition of female seals sampled from the kill, by age, St. Paul Island: 1-15 August 1967

| Reproductive condition | Age 2 | 3 | 4 | 5 | 6 | 7 and older | Total |
|---|---|---|---|---|---|---|---|
| Nonpost partum (number) | 2 | 104 | 192 | 160 | 103 | 373 | 934 |
| Post partum (number) | - | 1 | 5 | 65 | 72 | 285 | 428 |
| Pregnancy rate (percent) | - | 1 | 2 | 29 | 41 | 43 | 31 |

| | Pregnancy rate (Percent) |
|---|---|
| Age 3 and older | 31 |
| Age 4 and older | 34 |
| Age 5 and older | 39 |

pregnancy rates (table 8) are not representative of the total population of females because the animals killed were taken from hauling grounds. As a group, females on hauling grounds in 1967 had a pregnancy rate of about one-third that of females on the rookeries in other years, and about half that of females collected at sea during pelagic research.

## WEIGHTS OF PUPS

Data collected annually since 1957 on St. Paul Island to determine if the body weight of unmarked and untagged pups is related to the kill of males at age 3 have been inconclusive. The data for 1967 are discussed in the section on forecasts. In addition to the data on survival, information on weights shows that tagging, checkmarking, or handling (individually or combined) retards the growth of pups.

In 1967 we tested the variances and means (table 9) of the weights of untagged and unmarked pups from four rookeries. The variances and means for sexes and rookeries combined were significantly different ($P<0.001$). The variances were still significantly different when the sexes were tested separately ($P<0.05$). A test of the means with heterogeneous variances indicated that the mean weights differed significantly between rookeries for each sex ($P<0.001$).

Table 9.--Variances and means of weights of pups, St. Paul Island, 31 August 1967

| Sex and rookery | Sample size | Variance | Mean |
|---|---|---|---|
| | Number | | Kg. |
| Males | | | |
| Zapadni Reef..... | 100 | 4.4817 | 10.225 |
| Polovina..... | 100 | 3.8082 | 9.930 |
| Morjovi..... | 100 | 2.6043 | 10.435 |
| Reef..... | 100 | 2.6289 | 10.320 |
| Females | | | |
| Zapadni Reef..... | 100 | 2.6197 | 8.945 |
| Polovina..... | 100 | 3.1156 | 8.945 |
| Morjovi..... | 100 | 2.3759 | 9.230 |
| Reef..... | 100 | 1.6276 | 8.965 |

## MARKING

Fur seals of various ages have been given permanent marks to provide data for estimating the size of the population and for studying age and growth, mortality, distribution at sea, homing tendency, and commercial value of the skins. Application and recovery of marks are discussed in this section.

### APPLICATION OF MARKS

Monel cattle-ear tags have been used on the Pribilof Islands to mark fur seal pups since 1941 (table A-17) and older seals since 1961 (table A-18). Cryogenic branding is being tested as a way to permanently mark seals without injuring them.

### Marking in 1967

We marked pups of both sexes, yearling males, and 2- to 4-year-old males with Monel cattle-ear tags on the Pribilof Islands in 1967.

Pups.--Single T-series tags were attached to 9,980 pups on St. Paul Island (table A-19) and to 2,492 pups on St. George Island (table A-20). We attached the tags to the rear edge of the right front flipper at the hairline and removed the tip of the same flipper as a checkmark (fig. 8). Seals that lose their tags can be identified as to the year of birth by this checkmark.

Yearling male seals.--Males $\leq$ 98 cm. long (38 inches) or males marked or tagged as pups were double tagged or given an additional tag (1T-series) during late September and early October. A total of 835 males tagged as yearlings in 1967 (table A-21) included 48 that had been tagged or marked as pups in 1966 (table A-22). The mean length of 787 males selected as yearlings was 93.9 cm. (36.9 inches) and that of 48 males known to be yearlings was 92.6 cm. (36.4 inches). Nearly three-fourths of the males tagged were hauled out at English Bay. No females were tagged as yearlings.

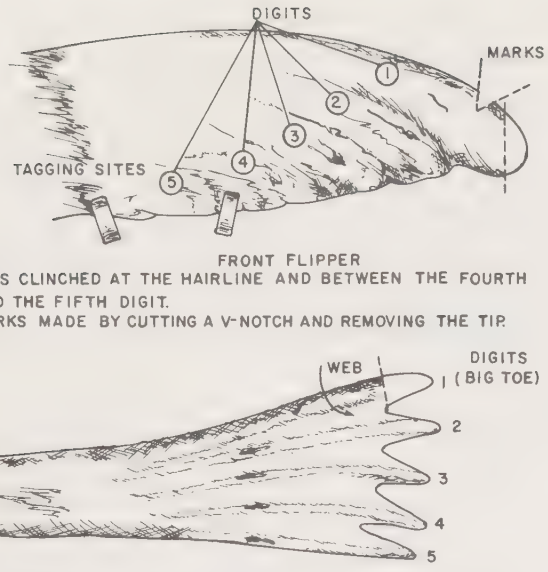



Figure 8.--Examples of mark locations that have been used on fur seals, Pribilof Islands, Alaska.

Male seals ages 2 to 4.--During the yearling tagging, 1,220 small males, larger and presumably older than yearlings, were double tagged with 2T-series tags (tables A-23 and A-24). Of the 1,220 males tagged, 140 had been tagged or marked as pups; 46 had R-series tags, 17 had lost their R-series tag, 48 had the first digit on the right hind flipper cut off, 26 had a V-notch mark on the right front flipper, and 3 had been tagged by the U.S.S.R. on the Commander Islands (tag numbers T-19559, T-22757, and T-19571). We did not record length for these animals.

We first tagged males in ages 2 to 4 in 1966. Recovery of the animals in the kill will provide information on mortality from one age to the next.

Cryogenic marking.--We described the process of cryogenic or "freeze" branding and trials on fur seals in 1966 in the 1966 (U.S. Fish and Wildlife Service, Bureau of Commercial Fisheries, 1969) report. We made additional tests in 1967.

In 1966, the shortest exposure to the supercooled branding instrument was 15 seconds. This treatment produced a legible mark composed of white hairs, but these were guard hairs only, which were growing primarily from the edges of the treated area. The underfur failed to grow back in. An application of 15 seconds was an overexposure that destroyed not only the pigment cells of the hair follicles but many of the hair follicles as well, particularly those producing underfur.

In 1967, we tried exposures of 5, 10, and 15 seconds at -68° C. on 12 artificially reared pups that were observed for up to 3 months. The 10-second application gave good depigmentation without skin damage. Five seconds of exposure produced insufficient white hairs, and 15 seconds caused skin damage. On 7 August we branded about 115 pups on both forearms for 10 seconds at -68° C. with a copper instrument in the shape of the letter "T," 1-inch (2.5-cm.) high and 3/8-inch (9.5-mm.) wide. Figure 9 is a photograph taken on 11 October when the new fur and guard hair were white on the treated area. Further testing is required to determine the proper mass-to-surface-area ratio for the head of a branding instrument to be used on fur seals.

We freeze-branded 16 adult females from Kitovi Rookery with 2- (5-cm.) and 3-inch (7.6-cm.) copper letter "U" "S" instruments, four each on the forearm, shoulder, chest, and rump. Exposures of 5, 10, 15, and 20 seconds will be identifiable by the position and direction of the brands. Odd-exposure (5- and 15-second) brands were put on the left side; even-exposure (10- and 20-second) brands were put on the right. Low-exposure (5- and 10-second) brands were placed parallel to the spinal column, and high-exposure (15- and 20-second) brands were placed perpendicular to the spinal column. We used 2-inch (5-cm.) brands on the forearm and rump, and 3-inch (7.6-cm.) brands on the shoulders and chest.

None of the freeze-branded females have been recognized since they were treated on 12 August.

## RECOVERIES OF MARKED SEALS

Tagged and marked seals taken on the Pribilof Islands in 1967 were within the length limits prescribed for killing untagged seals. This section deals with the recovery of these tags and marks.

### Recovery of Tags, Checkmarks, and Marks in 1967

A total of 5,466 marked seals recovered included 2,408 males and 356 females that had been tagged as pups (table 10), 1,228 males and 140 females that had lost their pup tags and were identified from checkmarks (table 10), 172 males and 3 females that had been marked as pups but not tagged (table 10), 361 males and 3 females selected and tagged as yearlings (table 11), 764 males tagged at age 2 and older (table 11), and 28 males and 3 females tagged as pups by the U.S.S.R. (table A-25). We recovered an additional 261 males that had lost two tags.

Figure 9.--Freeze-branded pup, Zapadni Reef Rookery, St. Paul Island, 11 October 1967.

Tables A-26 and A-27 show the recovery locations of males and females given tags or other marks as pups.

## Probability of Tag Loss

We calculated the rate or probability of tag loss from tags recovered and from checkmarks identified in 1967 (table 12). The rate of tag loss observed on St. George Island was somewhat less than that for St. Paul Island for Q-, P-, and O-series tags. Observers recovering tags on St. George Island believed that the checkmarks were less clear there than on St. Paul Island. Uniformity of checkmarks should be achieved in the future by using at least part of the same tagging crew on both islands. On St. Paul Island the rate of loss for R-series tags was about twice that for Q- and P-series tags. There is no apparent reason for this difference, but it may be a sampling error.

The probability of loss observed for tags applied to animals older than pups was 0.25 during the first year following application for 1S-series tags and 0.39 in 2 years after application for 1R-series tags. The 2S-series tags had a loss of 0.30 in 1 year.

## Effects of Time of Tagging

In 1963 and 1964, half the tags used on pups were applied 12-21 August and half 20-25 September to determine if time of application was related to rate of recovery. Recoveries from the 1963 experiment are nearly complete; the recoveries through age 4 for tags applied in September show a significantly higher rate of recovery ($P<0.01$) than for tags applied in August (table 13). The recoveries for the 1964 year class, though incomplete, show the same trend. We attached the tags applied in 1963 and in August 1964 at the hairline of the front flipper, and those applied in September 1964 between the fourth and fifth digits. The difference in site of application may affect the results of the experiment.

Table 10.--Tagged, lost-tag, and marked seals recovered, by age and sex, Pribilof Islands, Alaska, 26 June to 17 August 1967

| Date, sex, and mark or tag series | Age | Tagged seals | | | Lost-tag seals 1/ | | | Marked seals | | | Grand total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | St. Paul Island | St. George Island | Total | St. Paul Island | St. George Island | Total | St. Paul Island | St. George Island | Total | |
| | Years | Number | | | | | | | | | |
| 26 June to 5 August | | | | | | | | | | | |
| Males | | | | | | | | | | | |
| Front flipper mark 2/ | 2 | - | - | - | - | - | - | 82 | 12 | 94 | 94 |
| Hind flipper mark 2/ | 2 | - | - | - | - | - | - | 56 | 16 | 72 | 72 |
| R | 2 | 36 | 2 | 38 | 56 | 6 | 62 | - | - | - | 100 |
| Q | 3 | 1,225 | 338 | 1,563 | 558 | 89 | 647 | - | - | - | 2,210 |
| P | 4 | 490 | 166 | 656 | 313 | 48 | 361 | - | - | - | 1,017 |
| Ø | 5 | 79 | 39 | 118 | 92 | 22 | 114 | - | - | - | 232 |
| N | 6 | 5 | 1 | 6 | 32 | 5 | 37 | - | - | - | 43 |
| M | 7 | 1 | - | 1 | - | - | - | - | - | - | 1 |
| Total | | 1,836 | 546 | 2,382 | 1,051 | 170 | 1,221 | 138 | 28 | 166 | 3,769 |
| Females | | | | | | | | | | | |
| R | 2 | - | - | - | 1 | - | 1 | - | - | - | 1 |
| Q | 3 | 1 | - | 1 | 1 | - | 1 | - | - | - | 2 |
| P | 4 | 4 | - | 4 | - | - | - | - | - | - | 4 |
| Ø | 5 | 24 | 1 | 25 | 6 | - | 6 | - | - | - | 31 |
| N | 6 | 23 | - | 23 | 1 | - | 1 | - | - | - | 24 |
| M | 7 | 8 | - | 8 | - | - | - | - | - | - | 8 |
| L | 8 | 4 | - | 4 | - | - | - | - | - | - | 4 |
| K | 9 | 7 | 1 | 8 | - | - | - | - | - | - | 8 |
| J | 10 | 2 | - | 2 | - | - | - | - | - | - | 2 |
| I | 11 | 1 | - | 1 | - | - | - | - | - | - | 1 |
| H | 12 | 5 | - | 5 | - | - | - | - | - | - | 5 |
| G | 13 | 4 | - | 4 | - | - | - | - | - | - | 4 |
| E | 15 | 3 | - | 3 | - | - | - | - | - | - | 3 |
| CS | 18 | 3 | - | 3 | - | - | - | - | - | - | 3 |
| Total | | 89 | 2 | 91 | 9 | - | 9 | - | - | - | 100 |
| 8 to 17 August | | | | | | | | | | | |
| Males | | | | | | | | | | | |
| Front flipper mark 2/ | 2 | - | - | - | - | - | - | 2 | 1 | 3 | 3 |
| Hind flipper mark 2/ | 2 | - | - | - | - | - | - | 3 | - | 3 | 3 |
| R | 2 | 1 | 1 | 2 | - | 1 | 1 | - | - | - | 3 |
| Q | 3 | 6 | 14 | 20 | 2 | 3 | 5 | - | - | - | 25 |
| P | 4 | 2 | 1 | 3 | 1 | - | 1 | - | - | - | 4 |
| Ø | 5 | 1 | - | 1 | - | - | - | - | - | - | 1 |
| Total | | 10 | 16 | 26 | 3 | 4 | 7 | 5 | 1 | 6 | 39 |
| Females | | | | | | | | | | | |
| Front flipper mark 2/ | 2 | - | - | - | - | - | - | 2 | - | 2 | 2 |
| Hind flipper mark 2/ | 2 | - | - | - | - | - | - | 1 | - | 1 | 1 |
| R | 2 | 4 | - | 4 | 1 | - | 1 | - | - | - | 5 |
| Q | 3 | 19 | 13 | 32 | 24 | 8 | 32 | - | - | - | 64 |
| P | 4 | 34 | 13 | 47 | 27 | 2 | 29 | - | - | - | 76 |
| Ø | 5 | 64 | 28 | 92 | 43 | 3 | 46 | - | - | - | 138 |
| N | 6 | 36 | 11 | 47 | 22 | - | 22 | - | - | - | 69 |
| M | 7 | 13 | 4 | 17 | - | - | - | - | - | - | 17 |
| L | 8 | 5 | 1 | 6 | - | - | - | - | - | - | 6 |
| K | 9 | 8 | - | 8 | - | - | - | - | - | - | 8 |
| J | 10 | 3 | 1 | 4 | - | - | - | - | - | - | 4 |
| I | 11 | 3 | 2 | 5 | - | - | - | - | - | - | 5 |
| H | 12 | 1 | - | 1 | - | - | - | - | - | - | 1 |
| G | 13 | 1 | - | 1 | - | - | - | - | - | - | 1 |
| E | 15 | 1 | - | 1 | 1 | - | 1 | - | - | - | 2 |
| Total | | 192 | 73 | 265 | 118 | 13 | 131 | 3 | - | 3 | 399 |

1/ Seals that had lost their tags were identified from checkmarks at the time of tagging. In addition to those seals listed, 23 males and 1 female recovered on St. Paul Island had lost their tag but did not have a checkmark.

2/ Seals marked but not tagged -- V-notch right front flipper and tip of 1st digit right hind flipper sliced off.

Table 11.--Tag recoveries[1] from male seals that had been selected and tagged as yearlings and at age 2 or older in previous years, Pribilof Islands, Alaska, 26 June to 5 August 1967

| Age group, year tagged, and tag series | Age when: Tagged | Age when: Recovered | St. Paul Island | St. George Island | Total | Adjusted total[2] |
|---|---|---|---|---|---|---|
| | Years | Years | Number | Number | Number | Number |
| Yearlings | | | | | | |
| 1965 | | | | | | |
| R1 | 1 | 3 | 175 | 36 | 211 | 274 |
| R1 | 2 | 4 | 4 | 1 | 5 | 6 |
| R1 | ([3]) | | 11 | - | 11 | - |
| Total | | | 190 | 37 | 227 | 280 |
| 1966 | | | | | | |
| S1 | 1 | 2 | 63 | 20 | 83 | 108 |
| S1 | 2 | 3 | 39 | 4 | 43 | 57 |
| S1 | ([3]) | | 8 | - | 8 | - |
| Total | | | 110 | 24 | 134 | 165 |
| Age 2 and Older | | | | | | |
| 1966 | | | | | | |
| S2 | 1 | 2 | 8 | - | 8 | 12 |
| S2 | 2 | 3 | 478 | 69 | 547 | 706 |
| S2 | 3 | 4 | 149 | 24 | 173 | 223 |
| S2 | ([3]) | | 35 | 1 | 36 | - |
| Total | | | 670 | 94 | 764 | 941 |

[1] In addition to the seals listed, 215 males on St. Paul Island and 46 males on St. George Island that had lost two tags were taken, and 2 females with R1-series tags (one tagged at age 1 and one tagged at age 2) and 1 female with S1-series tag (tagged at age 1) were recovered.

[2] Adjusted to include animals of unknown age and 261 that had lost both tags. Animals of unknown age were allocated on the basis of the proportion observed in each age within each series and those that had lost both tags on the basis of the number observed in each age and tag series.

[3] The tags were recovered, but age could not be determined because either the flippers or the heads were separated from the carcasses during the skin-stripping process.

Table 12.--Tag loss observed, Pribilof Islands, Alaska, 1967

| Tags applied to pups | | | | | | | | Tags applied to seals older than pups 1/ | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | St. Paul Island | | | St. George Island | | | | St. Paul Island | | |
| Tag series | Age | Tags (a) | Lost tags (b) | Ratio (b)/(a)+(b) | Tags (a) | Lost tags (b) | Ratio (b)/(a)+(b) | Tag series | Both tags recovered | One tag lost 2/ | Ratio (b)/(a)+(b) |
| | Years | No. | No. | | No. | No. | | | No. | No. | |
| R | 2 | 36 | 56 | 0.61 | 2 | 6 | 0.75 | 1S | 77 | 51 | 3/ 0.25 |
| Q | 3 | 1,225 | 558 | 0.31 | 338 | 89 | 0.21 | 1R | 105 | 135 | 3/ 0.39 |
| P | 4 | 490 | 313 | 0.39 | 166 | 48 | 0.22 | 2S | 399 | 336 | 3/ 0.30 |
| O | 5 | 80 | 92 | 0.53 | 39 | 22 | 0.36 | | | | |

1/ Tags are applied to seals older than pups on St. Paul Island only.

2/ Includes some seals that had been single tagged as pups and given another tag at age 1 or older. The animal had lost one of the tags before it was killed.

3/ Incidence of tag loss (p), from double-tagged animals was calculated from the following formula: $p=n_1/(n_1+2n_2)$; where $n_1$ is number that lost one tag and $n_2$ is number that had lost a tag.

Table 13.--Tag recoveries, 26 June to 17 August 1967, from seals tagged as pups in August and September of 1963 and 1964[1] on St. Paul Island

| Year class | Age at recovery | Time of tagging | | | | Total |
|---|---|---|---|---|---|---|
| | | 12-21 August | | 20-25 September | | |
| | Years | Number | Percent | Number | Percent | Number |
| 1963 | 2 | 13 | 28 | 34 | 72 | 47 |
| | 3 | 354 | 38 | 568 | 62 | 922 |
| | 4 | 180 | 37 | 312 | 63 | 492 |
| Year class total | | 547 | 37 | 914 | 63 | 1,461 |
| 1964 | 2 | 49 | 47 | 56 | 53 | 105 |
| | 3 | 527 | 47 | 596 | 53 | 1,123 |
| Year class total | | 576 | 47 | 652 | 53 | 1,228 |

1/ Numbers of pups tagged: 12-21 August 1963 - 9,993; 20-25 September 1963 - 9,985; 12-21 August 1964 - 10,000; 20-25 September 1964 - 9,998.

## POPULATION ESTIMATES

Estimates of the number of pups and yearling males are presented in this section. Estimates of the pup population are based on three sources of data, tag or mark recoveries, shearing and sampling, and complete counts. Estimates of the yearling male population are based on tag recoveries.

### NUMBER OF PUPS BORN

Estimates of the number of pups at the time of tagging were made by combining the tag recovery data for St. Paul and St. George Islands (table 14). We derived an estimate of the total number of pups born by adding the count of dead pups on land to the estimate of the number of pups at the time of tagging (table 15). Estimates based on recoveries from males at ages 3 and 4, believed to be the most accurate, show a continuous but expected decline since 1960. The estimate of 416,000 in 1964 (table 15), however, is still about 40,000 greater than the estimate from shearing and sampling in that year--even with 20,000 pups added to the latter as a result of shearing and sampling on Sea Lion Rock. Estimates from the two sources (tag recoveries, and shearing and sampling) should become more nearly equal because of improvements in tagging. Shearing and sampling now produces the most accurate estimate. The error caused by additional mortality that results from the tagging of pups has not been completely eliminated.

Table 14.--Estimates of the pup population at time of tagging, based on tag recoveries from male seals killed 26 June to 5 August 1967 from year classes 1962-65, Pribilof Islands, Alaska

| Year class | Age | Killed | Tagged | Tag recoveries | Population estimate at time of tagging |
|---|---|---|---|---|---|
| | Years | Number | Number | Number | Number |
| 1962 | 5 | 1,679 | 49,908 | 233 | 358,321 |
| 1963 | 4 | 15,523 | 24,971 | 1,017 | 380,786 |
| 1964 | 3 | 34,613 | 24,991 | 2,210 | 391,247 |
| 1965 | [1] 2 | 2,940 | 10,000 | 100 | 291,217 |
| | [2] 2 | | 30,087 | 266 | 331,419 |

[1] Recoveries from males tagged as pups.
[2] Recoveries from males tagged or marked as pups.

We restricted shearing and sampling as a basis for estimating the pup population to two

Table 15.--Estimates of the number of pups born, based on tag recoveries and the count of dead pups, year classes 1960-65, Pribilof Islands, Alaska

| Year class | Pups alive at time of tagging 1/ | Count of dead pups | Total pups born |
|---|---|---|---|
| | Number | Number | Number |
| 1960 | 568,000 | 75,000 | 643,000 |
| 1961 | 489,000 | 71,000 | 560,000 |
| 1962 | 430,000 | 54,000 | 484,000 |
| 1963 | 407,000 | 39,000 | 446,000 |
| 1964 | 391,000 | 25,000 | 416,000 |
| 1965 | 331,000 | 46,000 | 377,000 |

1/ Estimates are based on tag recoveries from males of the year class killed at ages 3 and 4 for year classes 1960-63; at age 3 for year class 1964; and at age 2 for year class 1965.

rookeries (Tolstoi and Reef) in 1967 to eliminate one of the major causes of disturbance on the rookeries. Although we have no data to show conclusively that disturbance has a lasting detrimental effect, it is likely that it does. Compared to 1966, the mean estimate of the pup population increased from 27,000 to 33,500 on Tolstoi and decreased from 34,900 to 31,500 on Reef Rookery (table 16). We concluded from these data that the population did not change substantially from 1966 to 1967.

We made total counts of pups on Lukanin, Kitovi, Zapadni Reef, and Little Polovina Rookeries in 1967 (table 17). The 1967 counts were the first on Lukanin and Kitovi Rookeries, whereas the counts on Zapadni Reef and Little Polovina have been made each year since 1964. For the latter two rookeries, the number of pups counted in 1967 was 15 to 20 percent less than the number counted in 1966. The decrease indicated by the counts may be real or may have been caused by counting about 1 week later than usual--18 August compared to about 10 August. Counts made later in the season are inaccurate because the pups spend increasing amounts of time in the water as the season progresses. Counts made later than about 10 August would be likely to exclude pups and therefore be low.

Table 17.--Complete counts of live pups on selected rookeries in early August, St. Paul Island, 1963-67

| Rookery | 1963 | 1964 | 1965 | 1966 | 1967 |
|---|---|---|---|---|---|
| | Number | | | | |
| Little Polovina.. | 7,230 | 7,180 | 7,314 | 7,071 | 6,030 |
| Morjovi[1]..... | - | 17,530 | 18,384 | 17,388 | - |
| Zapadni Reef..... | - | 5,700 | 5,383 | 5,729 | 4,665 |
| Lukanin..... | - | - | - | - | 3,244 |
| Kitovi..... | - | - | - | - | 10,307 |

[1] Excluding point south of Sea Lion Neck.

There is no reason to suspect that the number of pups born has changed appreciably since 1966, the last year in which all the rookeries on St. Paul Island were sampled. Hence, the number of pups born in 1967 was about 385,000; that is, the estimated number (360,000) at time of shearing in 1966, plus about 25,000 pups that died before shearing.

## NUMBER OF YEARLING MALE SEALS

The number of yearling males has been estimated from the recovery of tags applied to yearling males from the 1961, 1962, 1964, and 1965 year classes (table 18). The data for the 1961 and 1962 year classes are practically complete, as very few additional recoveries will be made. The 1964 and 1965 year classes will yield additional recoveries. The estimated number of males in the 1964 year class (129,000) is considerably higher than the estimates for the 1961 and 1962 year classes (80,000). On the basis of the male kill from the 1964 year class at ages 2 and 3, the total number of males that will be killed from the year class may be about 14,000 greater than that from the 1962 year class. A difference of this magnitude indicates that the 1964 year class was stronger than the 1962 year class. Additional years of data are necessary to evaluate the estimates derived from this method.

The number of males that were actually yearlings when tagged was determined from

Table 16.--Estimates of the pup population on Reef and Tolstoi Rookeries, based on shearing and sampling, year class 1967, Pribilof Islands, Alaska

| Rookery | Pups sheared | First sampling, 14 August | | | | Second sampling, 18 August | | | | Mean estimate |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Samples | Total | Sheared | Estimated pup population at time of shearing | Samples | Total | Sheared | Estimated pup population at time of shearing | |
| | Number | | | | | | | | | |
| Reef..... | 4,677 | 135 | 3,375 | 464 | 34,019 | 151 | 3,775 | 611 | 28,896 | 31,458 |
| Tolstoi.. | 3,962 | 101 | 2,525 | 277 | 36,116 | 133 | 3,325 | 427 | 30,852 | 33,484 |

Table 18.--Estimates of the number of yearling male seals, based on tag recoveries, year classes 1961, 1962, 1964, and 1965, Pribilof Islands, Alaska

| Year class and tag series | Year when killed | Age when killed | Killed | Tags applied | Tags recovered[1] | Estimate of yearling males (N)[2] |
|---|---|---|---|---|---|---|
| | Year | Years | Number | Number | Number | Number |
| 1961 | | | | | | |
| (N) | 1963 | 2 | 2,019 | [3] 609 | 28 | 43,913 |
| | 1964 | 3 | 28,827 | | 226 | 77,680 |
| | 1965 | 4 | 14,638 | | 85 | 105,877 |
| | 1966 | 5 | 1,770 | | 14 | 76,995 |
| | | All ages | 47,254 | | 353 | 81,523 |
| 1962 | | | | [3] 523 | | |
| (O) | 1964 | 2 | 2,726 | | 41 | 34,773 |
| | 1965 | 3 | 22,745 | | 138 | 86,200 |
| | 1966 | 4 | 16,030 | | 98 | 85,549 |
| | 1967 | 5 | 1,679 | | 8 | 109,765 |
| | | All ages | 43,180 | | 285 | 79,239 |
| 1964 | | | | [4] 825 | | |
| (IR) | 1966 | 2 | 3,533 | | 40 | 72,868 |
| | 1967 | 3 | 34,613 | | 222 | 128,629 |
| 1965 | | | | [4] 1,415 | 88 | 47,274 |
| (1S) | 1967 | 2 | 2,940 | | | |

[1] Tags from animals of unknown age were divided on the basis of the proportion observed among animals of known ages.
[2] N=(MC)/R where M is number tagged, C is the kill, and R is the number of tags recovered.
[3] We assume an error of 0.032 in classifying seals by age during tagging.
[4] We assume an error of 0.059 in classifying seals by age during tagging.

the right upper canine teeth of those taken in the kill. For the 1961 and 1962 year classes the error in classification by age at the time of tagging was 3.2 and 5.9 percent, respectively. The data for the 1964 and 1965 year classes are incomplete; we assumed an error of 5.9 percent for these year classes.

## FORECAST OF THE KILL OF MALE SEALS IN 1968

A comprehensive review of the prediction methods that have been used over the past several years has been reported (U.S. Fish and Wildlife Service, Bureau of Commercial Fisheries, 1969). The most reliable method of forecasting the kill of 4-year-olds has been based on the kill of 3-year-olds from the year class, together with some measure of the timing of their return to the islands at age 3. The estimate of timing depends upon the kill per round (5-day period), which is affected by the behavior of the animals and by the management schedule. Management changes begun in 1967 have cast doubt on the validity of the measure of timing for the 1968 forecast. There is some uncertainity concerning the prediction of the kill of 4-year-olds, especially because the estimate of the number of yearlings from the 1964 year class suggests a higher kill.

Earlier reports referred to the use of estimates of the yearling population as a basis for forecasting, under the theory that most of the compensatory and variable mortality occurs during the first year of life. In other words, the survival rate after age 1 should be reasonably constant. Therefore, if good estimates can be obtained of the yearling survivors and of this constant survival rate from age 1 to ages 3 or 4, the problem of forecasting would be minimal.

Tagging of yearlings provides a marked cohort of known size in the 1-year-old group but this does not yield a population estimate until a random sample of this group has been subsequently obtained. The first such sample becomes available when these seals are killed at age 2, but so far the estimates from tag recoveries of 2-year-old males have been

unreasonably low compared to estimates from recoveries at ages 3 and 4. If the source of this bias was known, perhaps we could determine whether it is additive or multiplicative, and hence correct for it, or determine that it is variable and cannot be corrected. Without a complete understanding of the situation, we must proceed empirically. Thus, a reliable estimate through this method will be achieved, if at all, only after several more years of data are available.

## FORECAST OF THE KILL OF 4-YEAR OLD MALE SEALS ON ST. PAUL ISLAND

Four methods currently used to forecast the kill of 4-year-old males are: (1) Regression of the kill of 4-year-old males on the kill of 3-year-old males and the mean round[4] of the kill of 3-year-old males; (2) regression of returns at ages 3 and 4 on mean air temperature and on weights of live pups in autumn; (3) regression of the kill on the count of dead pups and the estimate of the pup population; and (4) estimate of returns based on estimates of the yearling population.

[4] Mean round = mean of rounds weighted by number taken by round. See glossary.

### Regression of the Kill of 4-Year-Old Male Seals on the Kill of 3-Year-Old Male Seals and the Mean Round of the Kill of 3-Year-Old Male Seals

In this regression the data from the 1953 and subsequent year classes are used, with 5 August considered the terminal date for the male kill and with adjustments made where necessary. Table 19 shows the data.

The resulting regression is:

$$\hat{Y} = 0.375X_1 + 14.19X_2 - 48.31$$

Table 19.--Data for regression of the kill of 4-year-old male seals based on the kill of 3-year-old male seals and mean round of the kill of 3-year-old male seals, year classes 1953-63, St. Paul Island

| Year class | Kill of 3-year-old males before 5 August ($X_1$) | Mean round of the kill of 3-year-old males 1/ ($X_2$) | Adjusted kill of 4-year-old males before 5 August 2/ (Y) |
|---|---|---|---|
| | Number | | Number |
| 1953 | 31,700 | 3.5 | 13,500 |
| 1954 | 19,800 | 3.4 | 8,700 |
| 1955 | 3/ 31,200 | 3.2 | 8,100 |
| 1956 | 4/ 11,700 | 3.3 | 1,900 |
| 1957 | 21,600 | 4.0 | 16,200 |
| 1958 | 38,900 | 3.8 | 21,000 |
| 1959 | 25,100 | 3.6 | 14,900 |
| 1960 | 14,000 | 3.7 | 10,800 |
| 1961 | 22,200 | 3.8 | 11,300 |
| 1962 | 15,200 | 4.0 | 15,100 |
| 1963 | 25,500 | 3.7 | 11,800 |

1/ The mean round of the kill of 3-year-old males through 5 August; kills before 7 July were pooled into the round of 7-11 July, and this period was considered as round 1.

2/ The kill of 4-year-old males before 5 August adjusted according to termination of the kill of 3-year-old males the previous year. If killing ended after 5 August, this figure was increased by 80 percent of the number of 3-year-old males taken after 5 August. If killing ended before 5 August, this figure was decreased by 80 percent of the estimated number of 3-year-old males that could have been taken from the actual termination date through 5 August.

3/ The killing of males in 1958 ended 31 July; an estimated 4,000 3-year-old males could have been taken 1-5 August.

4/ The killing of males in 1959 ended 31 July; an estimated 1,500 3-year-old males could have been killed 1-5 August.

The coefficient of multiple correlation is R = 0.946 ($R^2$=0.895). For the 1964 year class:

$X_1$=kill of 3-year-old males in 1965=27,000

$X_2$=mean round of the kill of 3-year-old males in 1967=3.43

so that

$\hat{Y}$=estimated kill of 4-year-old males in 1968=10,500.

The standard error (1,800) of $\hat{Y}$=is based on the assumption that $X_2$ is measured without error. Insofar as the round system was substantially modified in 1967, however, the value calculated for $X_2$ must be regarded as doubtful and, despite the small standard error, less weight should be attached to this forecast than to the others.

## Regression of Returns at Ages 3 and 4 on Mean Air Temperature and on Weights of Live Pups in Autumn

Table 20 shows the basic data for these regressions.

Because of the unequal lengths of the two series of data, we calculated two regressions. These are:

K=15.8+1.03T

K=8.33W-39.56

For the 1964 year class: T=15 and W=9.1; the two estimates are:

| | Temperature regression | Pup weight regression |
|---|---|---|
| Estimated kill at ages 3 and 4 (combined) ..... | 31,000 | 36,200 |
| Actual kill at age 3 . | 27,000 | 27,000 |
| Estimated kill at age 4 ..... | 4,300 | 9,200 |

The standard errors of these estimates are 9,600 and 10,300, respectively.

## Regression of Kill on Count of Dead Pups and Estimate of the Pup Population

In 1966, we developed a method for forecasting based on the count of dead pups and accumulative estimates of the pup population. We hoped that, when available, the estimates from shearing and sampling in the year of birth (fall sampling estimate) could be inserted into this procedure; however, the method involved calculation of the percentage of returns and the percentage of deaths on the islands. These percentages are extremely sensitive to sampling error in the total population estimate, which appears in the denominator. Thus it

Table 20.--The kill of 3- and 4-year-old male seals, mean air temperature, and weights of pups, year classes 1950-63, St. Paul Island

| Year class | Temperature (in tenths of a degree above 32°) (T) | Weights of live pups in autumn (W) | Kill at ages 3 and 4 (K) |
|---|---|---|---|
| | °F. | Kg. | Number |
| 1950 | 35 | - | 56,000 |
| 1951 | 36 | - | 50,000 |
| 1952 | 37 | - | 62,000 |
| 1953 | 16 | - | 47,000 |
| 1954 | 10 | - | 29,000 |
| 1955 | 17 | - | 38,000 |
| 1956 | 1 | - | 13,000 |
| 1957 | 23 | 8.7 | 40,000 |
| 1958 | 34 | 11.4 | 63,000 |
| 1959 | 33 | 9.4 | 41,000 |
| 1960 | 26 | 9.8 | 25,000 |
| 1961 | 18 | 8.5 | 35,000 |
| 1962 | 21 | 9.2 | 31,000 |
| 1963 | 28 | 8.9 | 37,000 |

Table 21.--Estimated number of pups born, count of dead pups, and number of male seals killed at ages 3 and 4, year classes 1950-63, St. Paul Island

| Year class | Estimated pups born 1/ (B) | Count of dead pups (D) | Kill from year class at ages 3 and 4 (K) |
|---|---|---|---|
| | Number | Number | Number |
| 1950 | 450,000 | 56,000 | 56,000 |
| 1951 | 450,000 | 74,000 | 50,000 |
| 1952 | 450,000 | 45,000 | 62,000 |
| 1953 | 450,000 | 82,000 | 47,000 |
| 1954 | 450,000 | 101,000 | 29,000 |
| 1955 | 450,000 | 79,000 | 38,000 |
| 1956 | 450,000 | 104,000 | 13,000 |
| 1957 | 420,000 | 65,000 | 40,000 |
| 1958 | 387,000 | 33,000 | 63,000 |
| 1959 | 341,000 | 42,000 | 41,000 |
| 1960 | 320,000 | 66,000 | 25,000 |
| 1961 | 329,000 | 61,000 | 35,000 |
| 1962 | 317,000 | 48,000 | 31,000 |
| 1963 | 300,000 | 34,000 | 37,000 |

1/ Cumulative estimates. The multiple regression is:

$$K=0.09+0.21B-0.69D$$

seems desirable to use a method that does not possess this disadvantage. A regression has therefore been calculated based directly on the counts and estimates (the data of table 21).

For the 1964 year class, the estimated number of pups born (the count of dead pups plus the estimate from shearing and sampling) was 285,000; substituting B=285, D=23 yields K=44.8. Since the kill at age 3 has been 27,000, the number remaining for the kill at age 4 is 17,800. The standard error (assuming no error in the estimate of the 1964 pup population) is 6,400.

### Estimate of Returns Based on Estimates of the Yearling Male Seal Population

Estimates of the yearling population based on recoveries of tagged seals at different ages and the recent kills are shown in tables 18 and 22. The kill through age 4 represented 45.8 percent of the estimate of yearlings of the 1961 year class, based on recoveries at age 3; for the 1962 year class the corresponding figure was 39.1 percent. The average of these is 42.4 percent (standard error 4.8 percent). Application of this percentage to the estimate of yearlings from recoveries of seals at age 3 from the 1964 year class yields an estimated total kill (ages 2 to 4) of 54,500, and hence, a balance to be taken at age 4 of 24,400. The standard error is 7,200.

## COMBINED ESTIMATES OF THE KILL OF 4-YEAR-OLD MALE SEALS ON ST. PAUL ISLAND

The several estimates and their standard errors are:

| Method | Estimate | Standard error |
|---|---|---|
| Regression of the kill of 4-year-old males on the kill of 3-year-old males and the mean round of the kill of 3-year-old males | 10,500 | >1,800 |
| Regression of returns at ages 3 and 4 on mean air temperature | 4,300 | 9,600 |
| Regression of returns at ages 3 and 4 on weights of pups | 9,200 | 10,300 |
| Regression of the kill on the count of dead pups and the estimate of the pup population. | 17,800 | >6,400 |
| Estimate of returns based on estimate of the yearling population | 24,400 | 7,200 |

The weighted average of these estimates is 12,700, if the standard error of the first estimate is accepted at face value--which gives this estimate most of the weight (44 percent). The unweighted average of the five estimates is 13,200. We therefore estimate that 13,000

Table 22.--Estimates of the yearling male seal populations, year classes 1961-62 and 1964-65, St. Paul Island

| Year class | Estimate of yearling population from tag recoveries | | | Kill at ages 2 and 3 | Kill at ages 2, 3, and 4 |
|---|---|---|---|---|---|
| | Age 2 | Age 3 | Age 4 | | |
| | Number | Number | Number | Number | Number |
| 1961 | 43,900 | 77,700 | 105,900 | 23,600 | 35,600 |
| 1962 | 34,800 | 86,200 | 85,500 | 21,500 | 33,700 |
| 1963 | - | None | - | 26,800 | 38,600 |
| 1964 | 72,900 | 104,200 | - | 30,100 | - |
| 1965 | 38,500 | - | - | - | - |

4-year-old males will be available in 1968. The several estimates are obviously rather widely divergent, and hence we need not emphasize that the estimate of the kill of 4-year-olds in 1968 is less reliable than in past years.

## FORECAST OF THE KILL OF 3-YEAR-OLD MALE SEALS ON ST. PAUL ISLAND

Three regressions used to forecast the kill of 4-year-old males have also been used to predict the kill of 3-year-old males. The regressions are:

(1) Temperature regression: K=15.8+1.03T. For the 1965 year class, T=12, so estimated kill at ages 3 and 4=28,200 with a standard error of 9,800.

(2) Pup weight regression: K=8.33W-39.56. For the 1965 year class: W=9.5 so estimated kill at ages 3 and 4=39,600 with a standard error of 10,600.

(3) Count of dead pups and pup estimate regression:

K=0.9+0.21B-0.69D For the 1965 year class: B=267 and D=41 so estimated kill at ages 3 and 4=28,700 with a standard error of at least 6,500.

The estimate of the pup population in 1965 seems low in comparison with the estimates of the number of pups born in 1964 and 1966.

The use of the factor 0.67 to estimate the kill at age 3 from estimates at ages 3 and 4 combined yields the estimates 18,900, 26,500, and 19,200, respectively.

Estimates of the number of yearlings are shown in table 22. Estimates based on recoveries at age 2 have been low in all years when checking has been possible. The relation between the estimated number of yearling males based on recoveries at age 2 and the kill in thousands of the same year class at ages 2 and 3 is:

$$K_{(2+3)} = 22.4+0.23Y$$

where Y yearling estmate based on recoveries at age 2.

For the 1965 year class:

$$Y = 38.5, \text{ so } K_{(2+3)} = 31.3.$$

Since the kill at age 2 has been 2,200, the estimated kill at age 3 by this method for St. Paul Island is 29,100. The standard error of this estimate is near zero.

## COMBINED ESTIMATES OF THE KILL OF 3-YEAR-OLD MALE SEALS ON ST. PAUL ISLAND

The estimates and their standard errors are:

| | Estimate | Standard error |
|---|---|---|
| Temperature regression..... | 18,900 | 9,800 |
| Pup weight regression..... | 26,500 | 10,600 |
| Regression on count of dead pups and estimate of pup population ..... | 19,200 | >6,500 |
| Yearling estimate ..... | 29,100 | 0 (?) |

Since these estimates are reasonably similar and we are in doubt about the standard errors of two of the estimates, it is simplest and not inaccurate to use an unweighted average. This average is 23,000, rounded to the nearest thousand.

## FORECAST OF THE TOTAL KILL ON THE PRIBILOF ISLANDS

Table 23 shows the forecast of the total kill of males on the Pribilof Islands in 1968. We have rounded the number of males in ages 2 and 5 to the nearest five hundred. The forecasted kill for both islands was determined by the usual method, that of extrapolating the estimates for St. Paul Island to St. George Island by a factor of 1.25. Because we believed the estimates were low, they were rounded upward.

The forecasted and actual kills of males in 1967 are compred in table 24.

The absolute error between the forecasted and actual total kill of slightly under 1,500 was almost identical with that obtained for the forecasted and actual total kill in 1966.

In 1967, the kill on St. George Island was 22.8 percent of the total, slightly higher than the long-term average of 20.0 percent.

Table 23.--Forecast of the kill of male seals in 1968, by age, Pribilof Islands, Alaska

| Island | Age | | | Total |
|---|---|---|---|---|
| | 2+5 | 3 | 4 | |
| | Number | Number | Number | Number |
| St. Paul | 3,500 | 23,000 | 13,000 | 39,500 |
| St. George | 1,000 | 6,000 | 4,000 | 11,000 |
| Total | 4,500 | 29,000 | 17,000 | 50,500 |

Table 24.--Comparison of forecasted and actual kill of male seals, Pribilof Islands, Alaska, 1967

| Island | Age | | | Total |
|---|---|---|---|---|
| | 2+5 | 3 | 4 | |
| | Number | Number | Number | Number |
| St. Paul | | | | |
| Actual | 3,487 | 26,991 | 11,785 | 42,263 |
| Forecast | 3,000 | 27,500 | 14,300 | 44,800 |
| St. George | | | | |
| Actual | 1,132 | 7,622 | 3,738 | 12,492 |
| Forecast | 1,000 | 6,800 | 3,600 | 11,400 |
| Combined | | | | |
| Actual | 4,619 | 34,613 | 15,523 | 54,755 |
| Forecast | 4,000 | 34,300 | 17,900 | 56,200 |

## SPECIAL STUDY: NUTRITION OF PUPS

The nutritional requirements of newborn fur seals have been studied since 1963 by analyzing fur seal milk and by feeding various formulas. The primary purpose of these efforts has been to make newborn fur seals available for studies in a controlled environment.

In 1967, a feeding trial was conducted to: (1) test the theory that the addition of selenium, vitamin E, methionine, and glycerin to the diet enhances the utilization of fatty acids, and (2) provide subjects for experiments in freeze-branding and disease susceptibility. Three pups were fed formula (table 25) with selenium, vitamin E, methionine, and glycerin added; and three were fed formula without this supplement.

The pups were captured when 1 to 3 days old and had presumably nursed. On the first day they were weighed and bathed, had their

Table 25.--Formula for artificial milk fed to captive pups, St. Paul Island, 9 July to 13 August 1967

| Component | Percent |
|---|---|
| Protein | |
| Fish flour (fine grind for animal use, 73 percent protein) 1/ | 9.1 |
| Casein (85 percent protein) 2/ | 4.5 |
| Fat | |
| Whale oil (baleen, bleached triglyceride) 3/ | 36.0 |
| Water | 49.5 |
| Supplement | |
| BO-SE (R) 4/ selenium, and d-alpha tocopherol | 0.00001 |
| | .0075 |
| DL methionine 2/ | .4 |
| Glycerin 5/ | .4 |
| Antioxidant | |
| Ethoxyquin (Santoquin (R) ) 6/ | .01 |
| Emulsifier | |
| Lecithin (soybean, oil not removed) 2/ | .1 |

1/ VioBin Corp., Monticello, Ill. (References to trade names in this publication do not imply endorsement of commercial products.)
2/ Nutritional Biochemicals Corp., Cleveland, Ohio
3/ Del Monte Fishing Co., San Francisco, Calif., and BCF Technology Laboratory, Seattle, Wash.
4/ Haver Lockhart, Kansas City, Mo.
5/ Colgate-Palmolive Co., New York, N.Y.
6/ Monsanto Chemical Co., St. Louis, Mo.

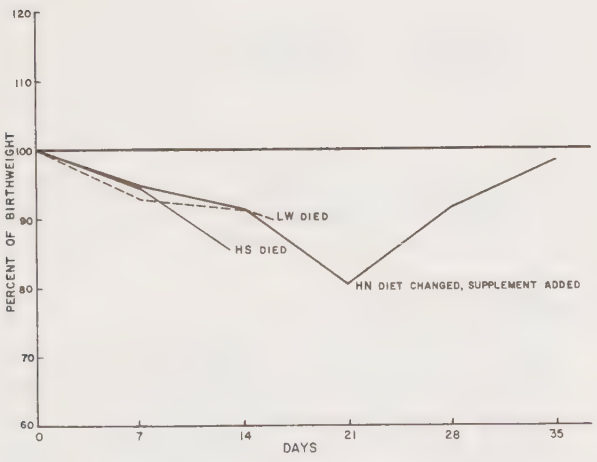



Figure 10.--Relation between birthweights and subsequent weights of three pups fed formula without added selenium, vitamin E, methionine, and glycerin, St. Paul Island, 9 July to 13 August 1967. The letters identify the individuals.

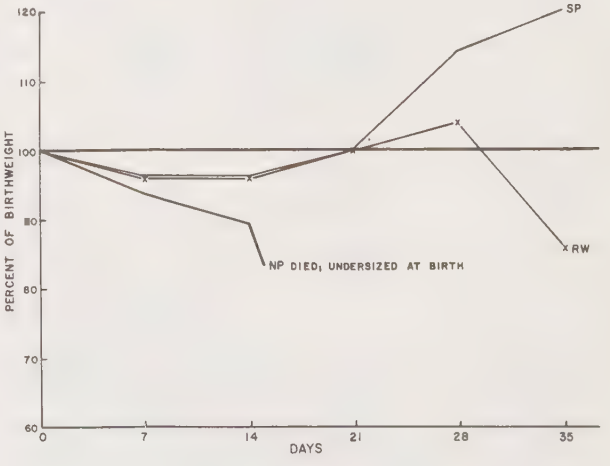



Figure 11.--Relation between birthweights and subsequent weights of three pups fed formula with selenium, vitamin E, methionine, and glycerin added, St. Paul Island, 9 July to 13 August 1967. The letters identify the individuals.

umbilical cords disinfected, and were freeze-branded for identification. Eight days later they were dipped in a solution of lindane to remove lice, and on the 16th day were given oral thiabendazole for hookworms. The pups had access to a sea-water pool after the 12th day.

Feeding was by stomach tube and a plastic syringe of 230 ml. capacity. Starting with 60 ml., we increased the amount of formula 10 ml. per feeding until each pup was getting 120 ml. twice daily. On the 14th day we increased the amount of formula per feeding to 130 ml., and by the 25th day to a maximum of 150 ml. twice a day.

The results were evaluated by comparing longevity and rates of gain or loss in weight during a 35-day period (figs. 10 and 11). The three pups fed formula without the supplement lost weight steadily and rapidly. One died in 14 days and one in 16 days; the third began a dramatic recovery when the supplement was added to his diet on the 21st day. Except for an undersized male that lost weight from the beginning and died in 15 days, the pups fed formula containing the supplement gained weight steadily after the usual small loss following birth. One of these pups contracted a bacterial enteritis and began to lose weight after the 28th day; however, a female reached 120.4 percent of her birthweight in 35 days, the best weight gain yet obtained for any artificially reared, newborn fur seal.

We conclude that one or more of the components of the supplement was essential for the survival and growth of newborn fur seal pups fed the artificial diet.

## SUMMARY

### AGE CLASSIFICATION AND NUMBER OF SEALS KILLED, BY SEX

#### Males

A kill of 54, 891 males in ages 2 to 6 included 42,359 taken on St. Paul Island and 12,532 taken on St. George Island. The limits for killing males in 1967 were from 107 cm. (42 inches), tip of nose to tip of tail, up to but not including those having manes. An additional 829 young males of unknown ages were taken during the kill of females.

#### Females

The kill of females in 1967 was 10,096, of which 7,502 were taken on St. Paul Island and 2,594 were taken on St. George Island. Most (7,170) of the females were taken during a special season 7-17 August; 2,926 were taken during the kill of males from 26 June to 5 August.

### SURVEY DATA

#### Mortality

Pups.--The count of dead pups on the Pribilof Islands in 1967, including an addition of 5 percent for pups overlooked during the counts, was 17,426--St. Paul Island contributed 14,780, and St. George Island, 2,646.

The major causes of death among 232 pups autopsied from 29 June to 15 August were malnutrition (31 percent), liver damage-multiple hemorrhage-perinatal complex (14 percent), hookworm disease (16 percent), and infections (9 percent). Trauma and miscellaneous causes of death accounted for 13 percent; 10 percent of the pups were unsuitable for examination, and the cause of death could not be determined for 7 percent.

Adults.--The number of dead adult males counted on St. Paul Island was 158 in 1965, 181 in 1966, and 108 in 1967; 41 were counted on St. George Island in 1966 and again in 1967. The number of dead adult females counted on St. Paul Island was 172 in 1966 and 157 in 1967; 55 were counted on St. George Island in 1966 and 28 in 1967.

#### Counts of Living Adult Male Seals

On the basis of the proportional change observed on five sample rookeries between 1966 and 1967, we estimated totals of 7,230 harem and 4,439 idle males on St. Paul Island in 1967--a reduction from 1966 of 9 percent for harem males and 24 percent for idle males.

On St. George Island the number of harem males counted in 1967 (1,646) was 17 percent less than the number counted in 1966 (1,974), whereas the number of idle males in 1967 (1,268) was 20 percent higher than in 1966 (1,017).

#### Reproductive Condition of Female Seals

Thirty-four percent of 1,255 females age 4 and older taken from hauling grounds had given birth to pups. These females had a pregnancy rate of about one-third that of females found on the rookeries in other years and about half that of females collected at sea.

#### Weights of Pups

One hundred untagged and unmarked pups of each sex were weighed on each of four rookeries in 1967. The mean weights differed significantly between rookeries for each sex ($P<0.001$).

## MARKING

### Pups

Single T-series tags were attached to the right front flippers of 9,980 pups on St. Paul Island and 2,492 pups on St. George Island. The tip of the same flipper was removed as a checkmark.

One hundred fifteen pups on St. Paul Island were experimentally marked by freeze-branding the letter "T" on their forearms. An exposure of 10 seconds gave good results.

### Yearling Male Seals

Double 1T-series tags were attached to the front flippers of 835 males selected as yearlings on St. Paul Island.

### Male Seals Ages 2 to 4

Double 2T-series tags were attached to the front flippers of 1,220 males in ages 2 to 4 on St. Paul Island.

## RECOVERIES

### Tags, Checkmarks, and Marks

Recoveries of seals marked as pups on the Pribilof Islands included 2,764 with tags, 1,368 with checkmarks, and 175 that had been marked but not tagged. Thirty-one seals tagged as pups by the U.S.S.R. were killed on the Pribilof Islands in 1967, and 364 seals tagged as yearlings and 764 tagged at ages 2 to 4 on St. Paul Island were recovered. An additional 261 seals that had lost two tags were taken.

### Tag Loss

Among seals tagged as pups, the rate of tag loss observed on St. George Island was less than that for St. Paul Island for Q-, P-, and O-series tags. The rate of loss for R-series tags was about twice that for Q- and P-series tags.

The probability of loss for tags applied to seals at age 1 was 0.25 during the first year following application for 1S-series tags and 0.39 in 2 years for 1R-series tags. There was a loss of 0.30 in 1 year for 2S-series tags.

### Time of Tagging

Tags applied to pups in September of 1963 and 1964 have since been recovered at a significantly higher rate than tags applied to pups in August of the same years.

## POPULATION ESTIMATES

### Number of Pups Born

On the basis of tag recoveries, the estimated number of pups born on the Pribilof Islands has steadily decreased from 643,000 in 1960 to 377,000 in 1965.

On the basis of shearing and sampling live pups on Reef and Tolstoi Rookeries for marked-to-unmarked ratios, the number of pups born on the Pribilof Islands in 1967 was about equal to the estimated 385,000 pups born in 1966.

### Number of Yearling Male Seals

On the basis of recoveries of male seals tagged as yearlings, the Pribilof Islands had an estimated 79,000 yearling males in 1963, and 129,000 in 1965.

## FORECAST OF THE KILL OF MALE SEALS

The predicted kill of males on the Pribilof Islands by 5 August 1967 was 4,000 of ages 2 and 5, 34,300 of age 3, and 17,900 of age 4. Actual kills were 4,619 of ages 2 and 5, 34,613 of age 3, and 15,523 of age 4.

The predicted kill of males on the Pribilof Islands by 5 August in 1968 is 4,500 of ages 2 and 5, 28,000 of age 3, and 17,000 of age 4.

## SPECIAL STUDY: NUTRITION OF PUPS

Pups fed a formula without supplemental selenium, vitamin E, methionine, and glycerin lost weight and died within about 2 weeks; pups fed the supplement gained weight and were considered suitable for use in a disease susceptibility experiment.

## ACKNOWLEDGMENTS

The research program in 1967 was completed with the cooperation of C. Howard Baltzo, Program Director; Bertel W. Johnson, Management Staff Officer; Richard A. Hajny, Wildlife Management Biologist; Harold Thayer, Program Construction Supervisor; Victor Misiken, Sealer III Foreman; Alex Melovidov, Sealer I Foreman; Lee Paola, Superintendent, Oregon-Alaska Marine Products; and Iliodor Merculief, President, St. Paul Island Community Council.

## GLOSSARY

The following terms used in fur seal research and management on the Pribilof Islands have special meanings or are not readily found in standard dictionaries.

**Checkmark** A notch, slit, hole, or other mark made on a seal flipper when a tag is applied, to ensure later recognition of an animal that has lost its tag. See marked and lost tag.

**Drive** The act of surrounding and moving groups of seals on land from one location to another.

**Escapement** Seals that were not killed because they were too old, too large, or were not available.

**Female kill** That part of the annual harvest devoted principally to the kill of female seals, usually in August. See male kill.

**Hauling ground** An area, usually near a rookery, on which nonbreeding seals congregate. See rookery.

**Haul out** The act of seals moving from the sea to a rookery or hauling ground on shore.

**Homing tendency** The inclination of seals to return to the rookery where they were born.

**Known-age** Applied to seals for which age is definitely known because they bear an inscribed tag or have a certain combination of tag-scar and checkmark.

**Lost-tag** Applied to a seal known to have been tagged because it bears a checkmark.

**Lost-tag-to-tag ratio** The number of seals that have lost tags as compared with the number retaining tags.

**Male kill** That part of the annual harvest devoted principally to the kill of male seals, usually in late June, in July, and in early August. See female kill.

**Males, adult** Class 1 Shoreline - Full-grown males about age 10 and older without females but apparently with established territories at the high tide mark.

Class 2 Territorial without females - Full-grown males about age 10 and older without females but with established territories on the rookery.

Class 3 Territorial with females - Full-grown males about age 10 and older with females and established territories on the rookery.

Class 4 Back fringe - Full-grown and partly grown males about age 7 and older, without females and without territories, that are found along the inland fringe of the rookery.

Class 5 Hauling ground - Full-grown and partly grown males about age 7 and older, without females, that are found on traditional hauling grounds.

**Mane** Long, silver-colored guard hairs on the shoulders and on back of the neck--a secondary sex characteristic of males. The mane appears on some males at age 5, on most at age 6, and on all at age 7 or older.

**Marked** Seals that have been tagged or sheared so that they can be identified. Removing a digit from a hind flipper, cutting a V-notch in the leading edge of a front flipper near the tip, or slicing off the tip of a front flipper are also examples of marking. These marks, when applied to seals in conjunction with tags, are considered checkmarks. See checkmark and lost-tag.

**Marked-to-unmarked ratio** The number of marked seals compared with the number of unmarked seals.

**Pregnancy rate** Percentage of females that were carrying or had borne pups in the year of examination.

**Rookery** An area on which breeding seals congregate.

**Round** The sequence in which hauling grounds on St. Paul Island are visited to harvest seals. When used, a circuit or round of the hauling grounds is completed in 5 days and the procedure is repeated throughout the kill of males. The mean round of the kill is calculated by multiplying the round number by the number killed in that round and dividing the cumulative product by the cumulative kill.

**Roundup** The act of surrounding and collecting seals to be driven for harvesting, tagging, or other purposes.

**Tagged** Describes a seal having an inscribed metal tag or tags attached to one or more of its flippers.

**Tag recoveries** Includes tags recovered, marked seals recovered, and seals identified from checkmarks as having lost their tags. See checkmark, marked, and lost-tag.

# Part II. PELAGIC FUR SEAL INVESTIGATIONS

The objectives of pelagic research in 1967 were to collect information on the food habits of fur seal pups as they began to leave the Pribilof Islands in November and December, and to study the distribution and food of fur seals of all ages off Washington in January and February. One biologist (as part of the exchange of scientific personnel between Convention members) was sent to Japan to observe the methods used in pelagic fur seal research and in caring for sealskins. Biologists also worked aboard two research vessels off the coasts of Washington, Oregon, and northern California in late August and September to observe the distribution of fur seals.

## EQUIPMENT, METHODS, AND PERSONNEL

Two vessels were used in January and February 1967 for pelagic investigations off the Washington coast. The M/V Pribilof[5] was used principally for surveying offshore waters, and a smaller vessel, the M/V Tonquin,[6] was chartered for collecting seals. Transects were run at 28-km. (15-mile) intervals to determine the distribution of seals between lat. 46°00'N. and 49° 00' N. Distances of 635, 769, 596, 685, and 519 km. (343, 415, 322, 370, and 280 nautical miles, respectively) from shore were reached on five of the transects. Whenever transects were run, the crew on the bridge assisted the biologist watch for fur seals. Data recorded on seals included total number sighted, time each was sighted, number of animals in group, estimated distance from the vessel when abeam, and behavior of the animals (e.g., sleeping, resting, swimming, feeding). We calculated the location of each seal observed from the position of the vessel, which we plotted on a chart at hourly intervals.

[5] Bureau of Commercial Fisheries Pribilof Islands supply vessel; registered length 64 m. (210 feet), 1,200 gross tons, 14,000 horsepower, cruising speed 22.2 km. per hour (12 knots).

[6] Privately owned vessel; registered length 30 m. (99 feet), 200 net tons, 350 horsepower, cruising speed 16.7 km. per hour (9 knots).

The bridge of the Pribilof at eye level is 8.1 m. (26.5 feet) above the waterline, or about double that of the Tonquin. The greater height permitted observers to see about four times the area that could be seen from the Tonquin. The angle of vison from the Pribilof improved observation in disturbed seas, and her large size permitted the investigators to remain far offshore during storms. The Tonquin was used for survey and collection of seals over the Continental Shelf.

Fiscus, Baines, and Wilke (1964) and Fiscus and Kajimura (1967) have described the equipment and methods used to collect seals. Seals were shot with 12-gauge shotguns loaded with 00 buckshot. They were weighed, measured, and examined for tags, checkmarks, scars, general physical condition, barnacles, and algae. Stomachs, reproductive tracts, and all canine teeth were taken to the BCF MMBL (Marine Mammal Biological Laboratory) in Seattle where they were used in studies of food, reproduction, and age.

Most yearling seals were weighed, measured, frozen, and later examined in our laboratory for general body condition and parasites.

Appendix B gives the itinerary for the 1967 pelagic investigations.

## DISTRIBUTION

Research at sea comprised several phases. The primary program was a study of distribution, food, age, and reproductive condition of fur seals collected off Washington from 6 January through 12 February. Secondary programs included distribution of fur seals in the Bering Sea and in waters near the eastern Aleutian Islands in November and December of 1965 and 1966; observation of Japanese fur seal research at sea and at the field station in Ozuchi, Iwate Prefecture, Japan, during April and May 1967; distribution of fur seals off Washington, Oregon, and northern California in August and September 1967; and a study of marine organisms ingested by nursing fur seal pups.

### DISTRIBUTION OFF WASHINGTON IN JANUARY AND FEBRUARY 1967

Before 1967 the Bureau of Commercial Fisheries had done little research on fur seals off Washington in January and February. K. W. Kenyon and V. B. Scheffer (field notes

on file at MMBL)[7] sighted 10 seals on 18 December 1948 about 37 km. (20 nautical miles) west of Cape Flattery. On 10 February 1950 they sighted 69 seals during a flight from Cape Flattery south along the 183-m. (100-fathom) depth contour to the Columbia River (unpublished map on file MMBL). The largest concentrations of fur seals were seen off Grays Harbor.

Observations made more recently from vessels en route to the wintering grounds of fur seals off California follow: February 1958--2 days, 22 seals sighted, 1 collected; January 1959--3 days, 18 seals sighted, 1 collected; January 1966--1 day, 7 seals sighted; February 1966--1 day, 14 seals sighted.

Fur seal distribution off Washington from 6 January to 12 February 1967 is shown by month in figures 12 and 13.

Tables C-2 and C-3 show by month the length of time vessels occupied a square, the total number of seals seen and collected, and the number seen per hour.

Except for 24 seals seen during a cruise to 519 km. (280 miles) offshore on 26 January, very few seals were seen along offshore transects. Seals were most commonly seen within 111 km. (60 miles) of land. Generally, seals in offshore waters were more active than those observed along the Continental Shelf and inside the 183-m. (100-fathom) depth contour.

The time of arrival of the first seals off the coast of Washington to California (December) suggests that seals travel eastward or southeastward from the eastern Aleutian passes at a fairly regular rate and probably do not linger en route. They migrate slowly through waters near the Continental Slope and Shelf, where food is abundant.

We found seals numerous along, and on, the Continental Shelf from Grays Harbor northward towards Umatilla Reef in early February. In January and February, we usually saw seals off Cape Flattery, Wash., and westward to La Perouse Bank.

Surface water temperatures in the area surveyed off Washington varied from 6° to 10° C.; the temperature was usually 8° or 9° C.

Two observers at sea for 31 days off northern California, Oregon, and Washington during August and September 1967 saw two fur seals.

Tables C-4 and C-5 show the number of seals seen and collected off Washington from 6 January through 12 February 1967. The number seen and collected by 10-day periods in January and early February was less than that for 10-day periods in April 1965 (Fiscus and Kajimura, 1967). Storms made observations more difficult in January and February 1967. Seals were still migrating south through the area in January.

Table C-6 shows grouping of seals. Group size did not differ greatly from that of previous years.

Of 835 seals sighted off Washington in 1967, 131 were collected, 27 were wounded and lost, and 21 sank after they were killed. Tables C-7 and C-8 show numbers and percentages of all seals sighted, collected, wounded and lost, and killed and lost from 1958 to 1967.[8] There has been a small increase in the percentage of seals wounded and lost, and killed and lost in the past 2 years when compared with 1958 to 1965. The use of larger, less maneuverable vessels with high bows in 1966 and 1967 may have caused the increase.

Table 26 shows by month the age and sex of seals collected in 1967. We expected the yearling seals in the collection, because beachcombers in past years have reported the stranding of several 1-year-old tagged seals along the coasts of Oregon, Washington, and British Columbia during January and February.

Seals collected off Washington in January and February 1967 were younger than seals collected during the same period in 1966 (U.S. Fish and Wildlife Service, Bureau of Commercial Fisheries, 1969) off California. The percentage of the catch in different age categories in the respective areas was:

| | Ages 1 to 3 | | Ages 4 to 22 |
|---|---|---|---|
| | Male Percent | Female Percent | Male[1] and female Percent |
| Washington | 6.7 | 32.1 | 61.8 |
| California | 3.0 | 4.4 | 92.6 |

[1] One male, age 4, in the sample.

Some seals from the Pribilof Islands migrate into the western North Pacific Ocean in late autumn, but recoveries of tags from the Pribilof Islands suggest that most move into the eastern North Pacific.

There is some segregation of fur seals at sea by age and sex. Females of all year classes and young males of ages 1 to 4 are found in the Gulf of Alaska and the eastern North Pacific Ocean during winter and spring. Males more than 5 years old are not regularly found south of Dixon Entrance (lat. 54°30' N.). We found more females age 5 and older off California than off Washington in January and February.

The age and sex of fur seals collected by the United States off Washington by month

[7] K. W. Kenyon, Wildlife Research Biologist, Bureau of Sport Fisheries and Wildlife; and V. B. Scheffer, Wildlife Research Biologish, Bureau of Commercial Fisheries.

[8] Many seals sighted during this period were not hunted because sea conditions made hunting impractical, vessels were running observation transects, and it was impossible to hunt all seals sighted in large concentrations.

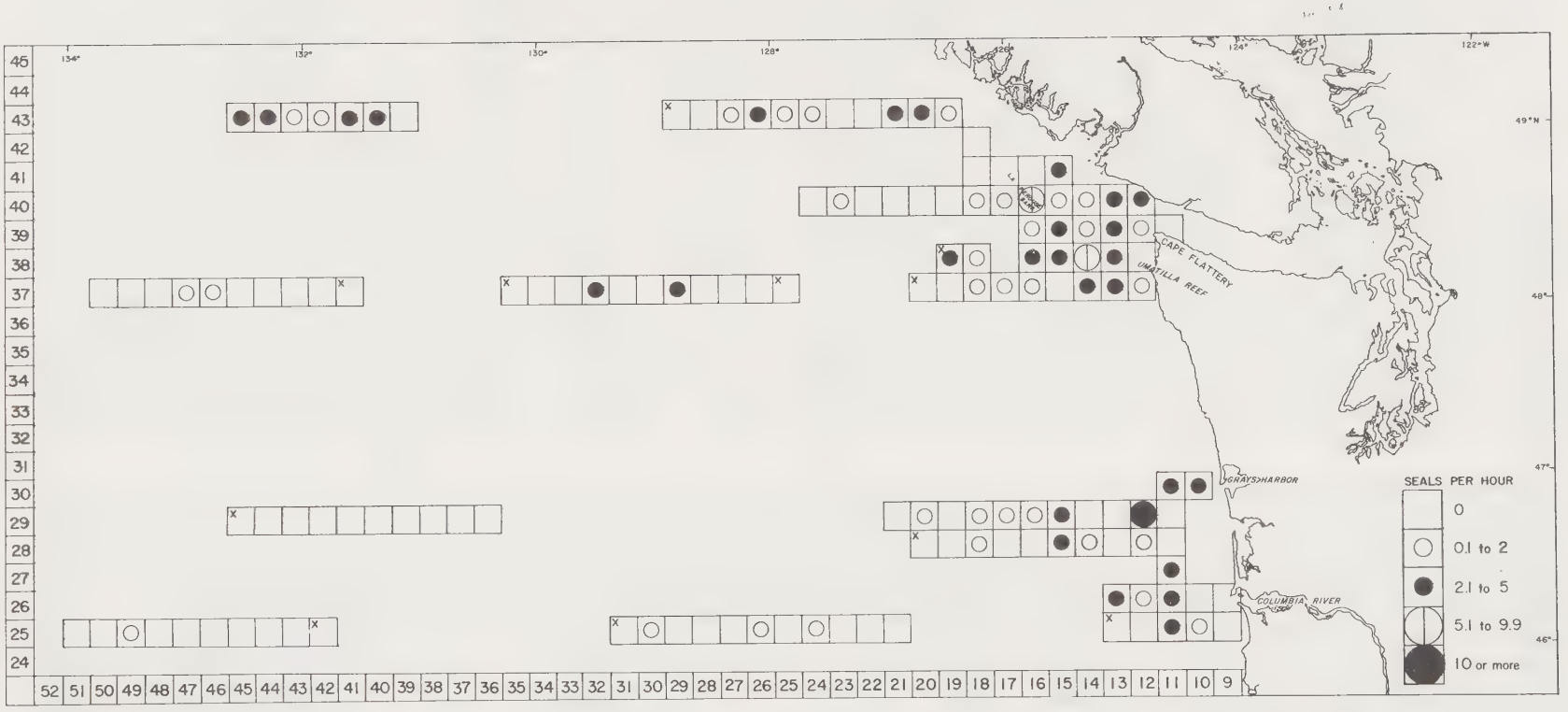



Figure 12.--Number of seals seen per hour of effort, in each square (areal unit) occupied by a research vessel in January 1967, off Washington. The sides of each square measure 18.5 km. (10 nautical miles). Squares occupied for less than 0.5 hour are marked "X." See table A-2 for detailed data.

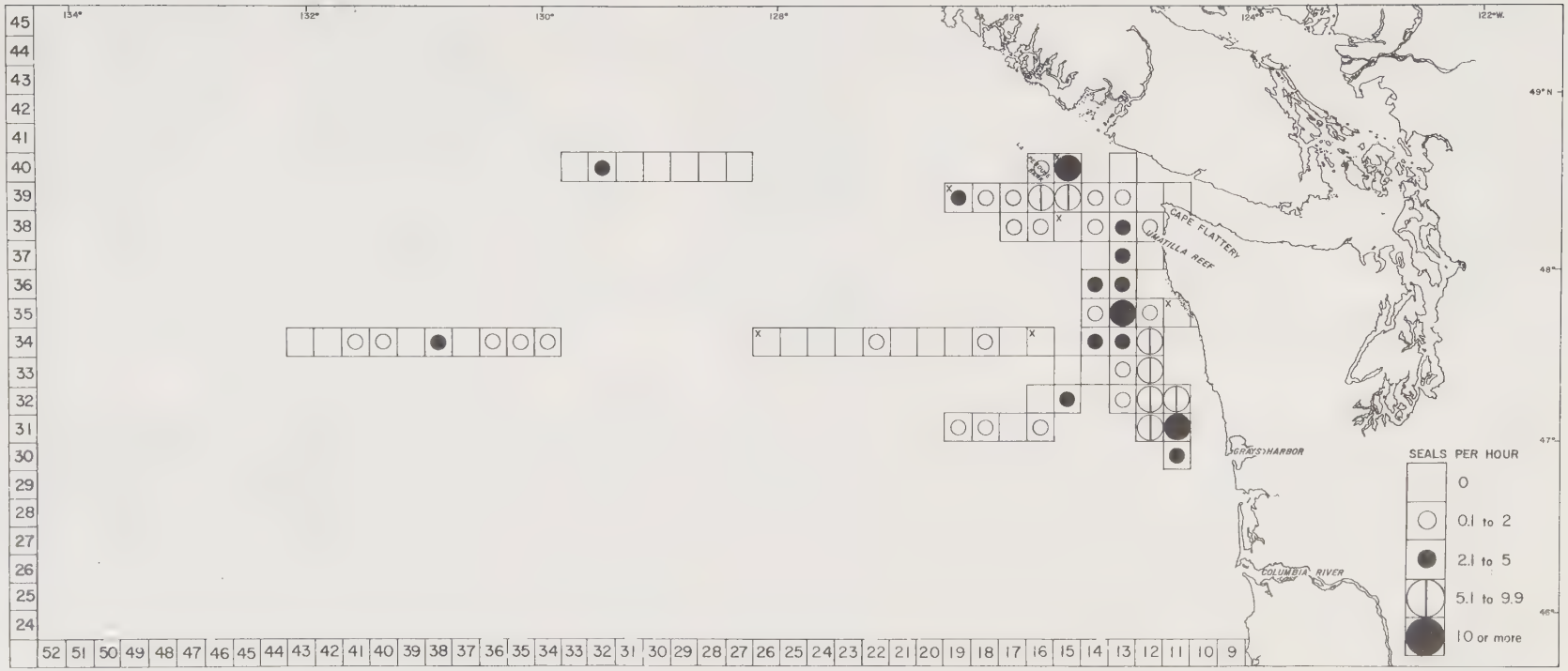



Figure 13.--Number of seals seen per hour of effort, in each square, (areal unit) occupied by a research vessel in February 1967, off Washington. The sides of each square measure 18.5 km. (10 nautical miles). Squares occupied for less than 0.5 hour are marked "X." See table A-3 for detailed data.

Table 26.--Age and sex, by month, of fur seals collected pelagically by the United States off Washington in 1967

| Age | January | | | | February | | | | Total | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Male | | Female | | Male | | Female | | Male | | Female | |
| Years | Number | Percent | Number | Percent | Number | Percent | Number | Percent | Number | Percent | Number | Percent |
| 1 | 2 | 28.6 | 3 | 4.1 | 4 | 66.7 | 3 | 6.7 | 6 | 46.1 | 6 | 5.1 |
| 2 | 3 | 42.8 | 2 | 2.7 | 2 | 33.3 | 1 | 2.2 | 5 | 38.5 | 3 | 2.5 |
| 3 | 1 | 14.3 | 4 | 5.5 | - | - | 6 | 13.4 | 1 | 7.7 | 10 | 8.6 |
| 4 | 1 | 14.3 | 5 | 6.9 | - | - | 4 | 8.9 | 1 | 7.7 | 9 | 7.6 |
| 5 | - | - | 6 | 8.2 | - | - | 3 | 6.7 | - | - | 9 | 7.6 |
| 6 | - | - | 14 | 19.2 | - | - | 6 | 13.4 | - | - | 20 | 17.0 |
| 7 | - | - | 3 | 4.1 | - | - | 4 | 8.9 | - | - | 7 | 5.9 |
| 8 | - | - | 4 | 5.5 | - | - | 3 | 6.7 | - | - | 7 | 5.9 |
| 9 | - | - | 10 | 13.7 | - | - | 2 | 4.4 | - | - | 12 | 10.3 |
| 10 | - | - | 6 | 8.2 | - | - | 5 | 11.1 | - | - | 11 | 9.4 |
| 11 | - | - | 3 | 4.1 | - | - | 1 | 2.2 | - | - | 4 | 3.4 |
| 12 | - | - | 2 | 2.7 | - | - | 1 | 2.2 | - | - | 3 | 2.5 |
| 13 | - | - | 2 | 2.7 | - | - | 1 | 2.2 | - | - | 3 | 2.5 |
| 14 | - | - | 1 | 1.4 | - | - | - | - | - | - | 1 | 0.8 |
| 15 | - | - | 1 | 1.4 | - | - | 2 | 4.4 | - | - | 3 | 2.5 |
| 16 | - | - | 5 | 6.9 | - | - | 1 | 2.2 | - | - | 6 | 5.1 |
| 17 | - | - | 2 | 2.7 | - | - | - | - | - | - | 2 | 1.7 |
| 20 | - | - | - | - | - | - | 1 | 2.2 | - | - | 1 | 0.8 |
| 22 | - | - | - | - | - | - | 1 | 2.2 | - | - | 1 | 0.8 |
| Total | 7 | | 73 | | 6 | | 45 | | 13 | | 118 | |

Table 27.--Age and sex, by month, of fur seals collected pelagically by the United States off Washington[1]

[Combined data for 1958-59, 1961, 1964-65, and 1967.]

| Month | Seals collected | Males[2] | | Females | | Females | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Ages 1-4 | | Ages 5-20+ | |
| | Number | Number | Percent | Number | Percent | Number | Percent | Number | Percent |
| Jan. | 81 | 8 | 9.9 | 73 | 90.1 | 14 | 19.2 | 59 | 80.8 |
| Feb. | 52 | 7 | 13.5 | 45 | 86.5 | 14 | 31.1 | 31 | 68.9 |
| Mar. | 58 | 11 | 19.0 | 47 | 81.0 | 11 | 23.4 | 36 | 76.6 |
| Apr. | 799 | 86 | 10.8 | 713 | 89.2 | 216 | 30.3 | 497 | 69.7 |
| May | 5 | 0 | 0.0 | 5 | 100.0 | 4 | 80.0 | 1 | 20.0 |
| June | 4 | 2 | 50.0 | 2 | 50.0 | 2 | 100.0 | 0 | 0.0 |

[1] Data for 1958 taken from Ford Wilke, Karl Niggol, and Clifford H. Fiscus. 1958. Pelagic fur seal investigations, California, Oregon, Washington, and Alaska, 1958. Bureau of Commercial Fisheries, Marine Mammal Biological Laboratory, Seattle, Wash. [Processed, 96 pp.]

Data for 1959 from Karl Niggol, Clifford H. Fiscus, Jr., and Ford Wilke. 1959. Pelagic fur seal investigations, California, Oregon, and Washington, 1959. Bureau of Commercial Fisheries, Marine Mammal Biological Laboratory, Seattle, Wash. [Processed, 92 pp.]

Data for 1961 from Clifford H. Fiscus, Karl Niggol, and Ford Wilke. 1961. Pelagic fur seal investigations, California to British Columbia, 1961. Bureau of Commercial Fisheries, Marine Mammal Biological Laboratory, Seattle, Wash. [Processed, 87 pp.]

Data for 1964 from Fiscus and Kajimura (1965); data for 1965 from Fiscus and Kajimura (1967).

[2] All males are age 5 or younger, except one 8-year-old.

since 1958 are shown in table 27. Generally, the age and sex composition of the population off Washington is similar to that of the population off California (U.S. Fish and Wildlife Service, Bureau of Commercial Fisheries, 1969). The proportion of females ages 1 to 4 years increases as summer approaches. This increase may be explained in part by the northward migration of gravid females and probably by a gradual increase in the number of young animals that are still appearing from seaward and moving south.

## DISTRIBUTION OFF WASHINGTON, OREGON, AND NORTHERN CALIFORNIA IN AUGUST AND SEPTEMBER 1967

The Marine Mammal Biological Laboratory has studied fur seals off the coasts of Washington, Oregon, and California at various times since 1958. The studies were made from late November through mid-June, when the animals are abundant in these waters. We have done little work in coastal waters from July through November because we do not normally expect fur seals there at that time. Several people, however, have seen fur seals off the coastal states during the summer and early autumn. For example, D. W. Rice, a whale biologist for the Bureau of Commercial Fisheries, saw a fur seal 30 August 1961 south of San Francisco (approximate lat. 36°58' N. and long. 122°58'W.) while aboard a whaling vessel (field notes on file at MMBL). According to Orr and Poulter (1965), James H. Miller (affiliation unknown) saw a fur seal 27 July 1965 on Año Nuevo Island, Calif., that apparently hauled out and left several times during the day. Peterson and Gentry[9] saw two adult males on Año Nuevo Island in 1967, one on 29 July and another for about a week beginning 1 October. Through the cooperation of the Bureau of Commercial Fisheries, Exploratory Fishing and Gear Research Base, Seattle, Wash., and the Department of Oceanography, Oregon State University, we placed observers aboard their vessels during three cruises in August and September 1967 to determine if fur seals are present then in appreciable numbers in coastal waters.

No fur seals were sighted 22 August through 6 September from the M/V John N. Cobb[10] (cruise 89) during 148.5 hours of observations along courses totaling 2,335 km. (1,260 nautical miles) off Washington and Oregon when weather and visibility were good (fig. 14).

We made observations 25 - 29 August and again 15 - 22 September from the M/V Yaquina[11] (fig. 14). Weather and visibility were excellent in August and from 15 to 17 September, but poor from 18 to 22 September. No fur seals were seen in August during 44.5 hours of observation along 700.9 km. (378.3 nautical miles) of water between the city of Newport and the Columbia River in Oregon. Two fur seals were seen in September along 1,389.2 km. (749.7 nautical miles) during 87 hours of observations between Newport, Oreg., and San Francisco, Calif. One of these was over Bodega Canyon (lat. 38°08' N., long. 123°40' W.) and the other 113 km. (61 nautical miles) west of Point St. George (lat. 41°48' N., long. 125° 36' W.). Both seals were sleeping when seen and were identified as females with white vibrissae.

[9] R. S. Peterson and R. L. Gentry. 1967. Biological investigations in Año Nuevo State Reserve, Annual Report 1966-67. Division of Natural Sciences, University of California, Santa Cruz. 20 pp. + 7 appendixes. [Processed.]

[10] Bureau of Commercial Fisheries Exploratory Fishing and Gear Research vessel; registered length 28 m. (93 feet), 345 horsepower, cruising speed 17 km. per hour (9 knots).

[11] Oregon State University research vessel; registered length 55 m. (180 feet), twin 500-horsepower engines, maximum speed 22 km. per hour (12 knots), height of bridge above waterline at eye level - 8 m. (26 feet).

## DISTRIBUTION IN THE BERING SEA AND NEAR THE EASTERN ALEUTIAN ISLANDS IN NOVEMBER AND DECEMBER 1965-66

The distribution of fur seals in the eastern Bering Sea and in waters near the eastern Aleutian Islands has been recorded at various times between mid-May and early October. In 1955,[12] 1958 and 1960 (North Pacific Fur Seal Commission, 1965); 1962 (Fiscus et al., 1964), 1963 (Fiscus et al., 1965), and 1964 (Fiscus and Kajimura, 1965), halibut schooners and purse seiners, 21 to 24 m. (70-80 feet) long, were used for fur seal investigations in this area during spring and summer.

Two cruises by Scheffer[13] and Kenyon[14] on the M/V Black Douglas, 45 m. (148 feet) long, from 27 October to 17 November 1947 between Unalaska and Attu, and 26 November to 6 December 1948 (Kenyon and Wilke, 1953; Wilke and Kenyon, 1954) from Unalaska to San Francisco were the only surveys made near the Aleutian Islands in late autumn or winter before 1965.

In 1965, the Fisheries Research Board of Canada sent the research vessel M/V G. B. Reed, 54 m. (177 feet) long, to determine if weather would permit sampling of fur seals in autumn and winter.[15] Ian B. MacAskie (FRBC, Biological Station, Nanaimo, British Columbia) supervised the cruise. C. H. Fiscus (Bureau of Commercial Fisheries Marine Mammal Biological Laboratory), accompanied the expedition. The G. B. Reed left Nanaimo on 10 November and returned 12 December 1965, working from 18 November to 3 December in waters adjacent to the eastern

[12] Ford Wilke. 1955. Alaska fur seal investigations, Pribilof Islands, Alaska, 1955. Bureau of Commercial Fisheries Marine Mammal Biological Laboratory, Seattle, Wash., 46 pp. [Processed.]

[13] Victor B. Scheffer. 1947. Research on fur seals and other marine mammals in 1947: a progress report on Project 80. Bureau of Commercial Fisheries Marine Mammal Biological Laboratory, Seattle, Wash., 20 pp. [Manuscript.]

[14] Karl W. Kenyon. 1948. Migration of the Alaska fur seal (Callorhinus ursinus). Bureau of Commercial Fisheries Marine Mammal Biological Laboratory, Seattle, Wash., 49 pp. + maps. [Manuscript.]

[15] G. C. Pike, I. B. MacAskie, and A. Craig. 1966. Report on Canadian pelagic fur seal research in 1965. Fisheries Research Board of Canada, Nanaimo, British Columbia, 7 pp., tables and appendix. [Processed.]

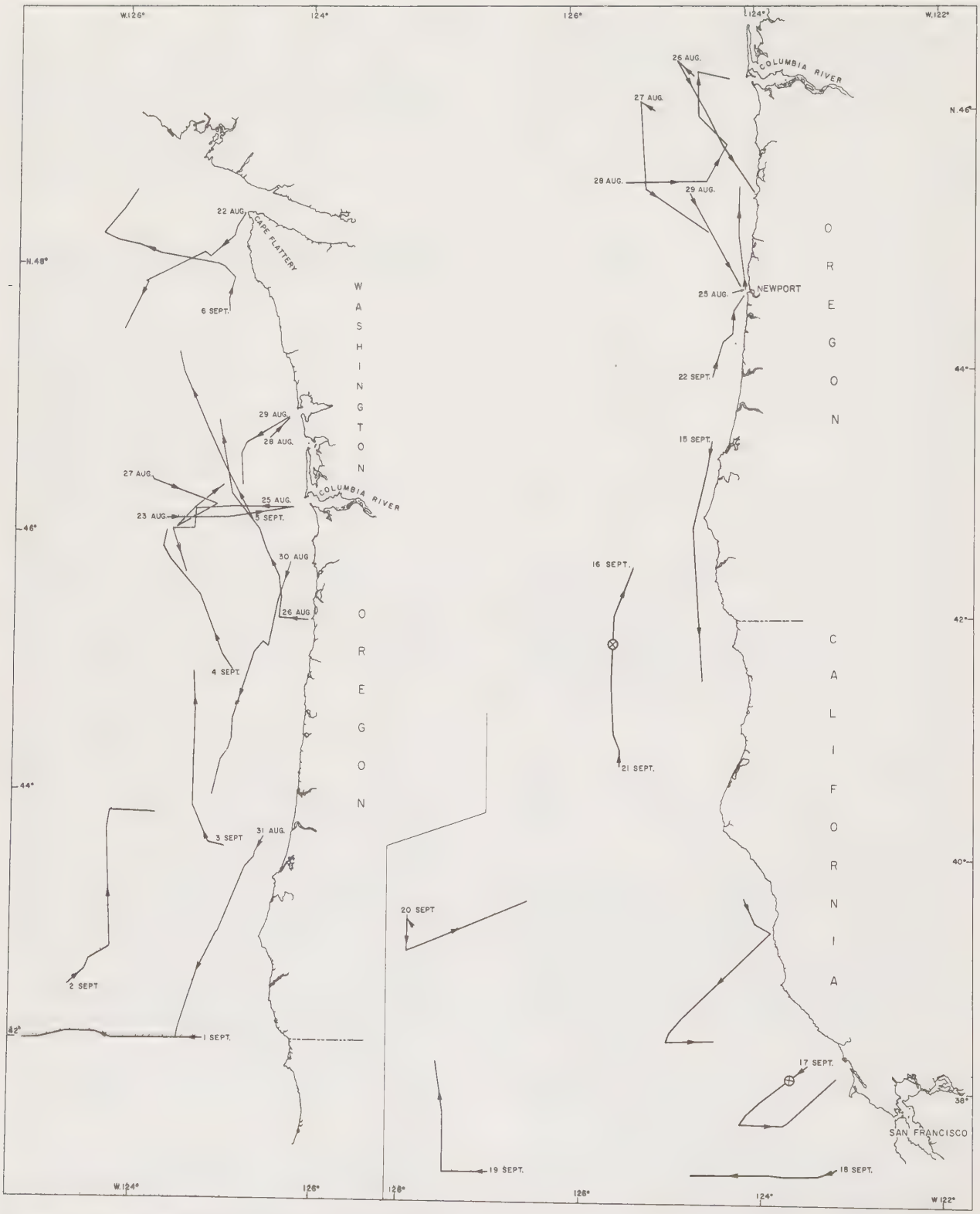



Figure 14.--Left: Trackline of M/V John N. Cobb during cruise for observation of fur seals, 22 August to 6 September 1967. Right: Trackline of M/V Yaquina during observations of 25 - 29 August and 15 - 22 September 1967. Fur seal sightings (two) are shown by ⊗.

Table 28.--Observations of fur seals[1] in waters adjacent to the eastern Aleutian Islands, 18 November to 3 December 1965[2]

| Date | Locality | Seals seen |
|---|---|---|
| | | Number |
| 18 Nov. | Off Cape Cheerful, Unalaska Island | 4 |
| 20 Nov. | Off Cape Cheerful, Unalaska Island | 5 |
| 26 Nov. | Unalaska, Akutan Pass to Avatanik Strait, Unimak Pass, and south side Ugamak Island | 25 |
| 28 Nov. | Unalaska off the waterfall | 1 |
| 1 Dec. | Off north side of Akutan Island | 4 |
| 2 Dec. | Akutan Pass | 2 |
| 3 Dec. | Unalga Pass to Unimak Pass | 6 |

[1] From Fisheries Research Board of Canada vessel M/V G. B. Reed.

[2] G. C. Pike, I. B. MacAskie, and A. Craig. 1966. Report on Canadian pelagic fur seal research in 1965. Fisheries Research Board of Canada, Nanaimo, B.C., 7 pp., tables and appendix. [Processed.]

Aleutian Islands. Table 28 gives results of this survey.

Storms in the Bering Sea in November and December made hunting extremely difficult during the cruise of the G. B. Reed in 1965 and of the Pribilof in 1966. Operations were usually restricted to the vicinity of the eastern Aleutian Islands, where vessels could work in somewhat sheltered waters. Daylight is about 8 hours in November and December. Observations or attempts to collect fur seals were made from the Pribilof during parts of 10 days; the vessel was stormbound for 5 days. The G. B. Reed was in the eastern Aleutian or Pribilof Islands areas for 17 days. Her crew made observations or attempts to collect fur seals during parts of 10 days. The G. B. Reed was stormbound or confined to making invertebrate surveys in sheltered waters for 7 days.

The Bureau of Commercial Fisheries vessel M/V Pribilof was used on a cruise in the Bering Sea from 20 November to 4 December 1966. The objectives were to study the autumn distribution, migration, and food of fur seals, with emphasis on pups as they leave the Pribilof Islands. Sixty-two seals were sighted: 37 in waters adjacent to the eastern Aleutian Islands (table 29); 22 on 20 November from 161 km. (87 nautical miles) SE. of St. George Island to 57 km. (31 nautical miles) NNE. of Cape Cheerful on Unalaska Island (a distance of 120 km. [65 nautical miles]); and 3 on 4 December from 41 km. (22 nautical miles) SSE. of St. George Island to the village of St. George and then to St. Paul Island. Storms prevented the collection of seals on 20 November; two of the three animals seen on 4 December were hunted without success. Except for a few animals that may have been sea lions in the water near East Reef Rookery, we saw no other seals ashore or in water near St. George Island.

According to Walter Dyakanoff (personal communication, 21 November 1966), a resident of Unalaska, both young and old seals were plentiful off Unalaska about 8 November, about 2 weeks before we arrived in the eastern Aleutian Islands.

C. H. Fiscus, resident biologist Richard A. Hajny, and biological technician Lavrenty Stepetin collected 20 fur seal pups on St. Paul Island in November. On 14 November they collected 4 from Zapadni Reef Rookery and 10 from Northeast Point Rookery. On 15 November they collected six from Zapadni Reef Rookery. The pups were collected primarily to determine if these small seals feed on invertebrates and fish before they leave the Pribilof

Table 29.--Observations and collections of fur seals around the eastern Aleutian Islands, 20 November to 4 December 1966[1]

| Date | Hours of observation | Locality | Seals seen 2/ |
|---|---|---|---|
| | | | Number |
| November | | | |
| 22 | 7 | Off Unalaska, Cape Cheerful to Akutan Island | 5 |
| 23 | 7 | Unalaska to Akun Bay, Akun I., north of Akutan Island | 8 |
| 25 | 6+ | West side of Unimak Pass | 2 |
| 26 | 4 | West side of Unimak Pass, Avatanik Strait | 0 |
| 28 | 8 | West side of Unimak Pass, north side of Akun Island | 8 |
| 29 | 8 | North side of Akun I., northwest side of Unimak Pass | 7 |
| 30 | 6 | North side of Akutan and Akun Is. | 5 |
| December | | | |
| 1 | 7 | Akutan Bay, north side of Akutan Island to Unalaska | 2 |

1/ From Bureau of Commercial Fisheries vessel M/V Pribilof.

2/ Three seals were shot during the cruise. One was collected on 23 November. It was a 12-year-old, unmarked and untagged female (field number US 66-388) taken at 1:15 p.m. at lat. 54°27' N., long. 165°38' W.; body length 131 cm. and weight 36 kg.; two seals in group; surface water temperature 5° C.; stomach with traces of two squid (Gonatidae) and one unidentified fish; multiparous with embryo in left uterine horn and recently (summer, 1966) post partum in right uterine horn; clean nipple crypts; milk in mammaries. One seal was killed and lost on 28 November, and one was wounded and lost on 29 November.

Islands on their first southward migration. They were weighed, measured, frozen, and shipped to the Marine Mammal Biological Laboratory, Seattle. Mark C. Keyes and Hiroshi Kajimura examined the seals for parasites and food remains. Few seals were seen on St. Paul Island during a survey of all rookeries and hauling grounds 5 to 8 December.

To supplement surveys made near the Aleutian Islands from the Black Douglas (1947-48), G. B. Reed (1965), and the Pribilof (1966), we summarize the reports from other sources of strandings, sightings, and land migrations of fur seals in the Bering Sea and the Aleutian Islands during autumn and early winter.

Richard S. Peterson's[16, 17] studies of the behavior of fur seals on St. Paul Island from 1961 through 1963 provide the most recent information on the departures of seals from the Pribilof Islands. Peterson defined a period

[16] Richard S. Peterson. 1962. Behavior of fur-seal pups; report of a preliminary study, 1961. Bureau of Commercial Fisheries, Marine Mammal Biological Laboratory, Seattle, and Johns Hopkins University, 59 pp. [Manuscript.]

[17] Richard S. Peterson. 1965. Behavior of the northern fur seal. Johns Hopkins University, D.Sc. Thesis, 12 + 214 pp.

of late nursing lasting from about 15 September to 20 October and a period of weaning from about 25 October to 25 November, followed by the departure of seals of all age classes. A few stragglers, especially older males, may stay. In 1961 the number of pups dropped sharply after 12 November, and none were seen after 27 November. The mean departure date for pups in 1962 was 8 November. Kenyon[18] stated that Wilke and Banner observed a decrease in fur seal pups from a count of 2,190 on 6 November to only 1 on 3 December at Kitovi Rookery in 1941. J. B. Crowley (In Jordan, 1898, part II.) observed a noticeable decrease of seals on St. Paul Island after 19 November 1886.

Peterson[19] stated that violent storms in November appeared to have more effect in causing the seals to leave than did low temperatures. His observations on St. Paul Island fit with those of Walter Dyakanoff (personal communication, 21 November 1966), who said that fur seal pups usually first appeared in the vicinity of Unalaska after periods of northeasterly gales.

Kenyon,[20] quoting Admiral Zeusler from Captain Hooper's report of 21 November 1892, reported that "A record kept at Unalaska for the past twelve years [1880-92?] shows the average date of the first appearance of seals in the bay [Unalaska Bay?] to be Oct. 24th and the average date of the last appearance to be Jan. 1st, the earliest and last dates being respectively Oct. 18 and Jan. 4th."

Fiscus et al. (1964) reported adult males in the vicinity of the eastern Aleutian Islands in August and immature females were abundant north of Unimak Pass in early October.

Scheffer[21] and Kenyon observed one or two seals daily along the north side of the Aleutian Islands, between Unalaska and Attu Islands, from 27 October through 17 November 1947.

In early November 1956, P. Hansen, affiliation unknown (letter, 1 November 1956), found a dead, tagged pup and "considerable numbers" of dead, untagged pups on the beach between Port Heiden and Port Moller on the north side of the Alaska Peninsula.

In November 1957, a Mr. Deigh, affiliation unknown (letter, 20 December 1957), of Egegik in Bristol Bay, mistakenly shot a fur seal pup for a land otter 16 km. (10 statute miles) upstream from the mouth of the Egegik River. The animal had been tagged in August of that year on the Pribilof Islands.

On 28 November 1957, A. H. Johnson, affiliation unknown (letter, 28 November 1957), found a dead tagged pup on the beach at Herendeen Bay on the north side of the Alaska Peninsula.

On 22 November 1960, V. Berns, Refuge Manager, Bureau of Sport Fisheries and Wildlife (letter, 22 November 1960), found a female fur seal pup crossing overland from Izembek Bay on the north side of the Alaska Peninsula to Cold Bay on the south side.

R. D. Jones (1963) reported on several overland migrations across the Alaska Peninsula from north to south in the late fall and early winter.

J. P. Cook, affiliation unknown (letter, 16 December 1963), found a dead, tagged pup on 16 December 1963 on a beach at the south end of Umnak Island.

In summary, a few fur seals of both sexes and of various year classes are in the eastern Bering Sea, on the Pribilof Islands, and near the eastern Aleutian Islands in all seasons; however, most of the animals leave in autumn or early winter and do not begin to return until May and June of the following year. Some adult males leave the Pribilof Islands in August or early September. Nursing females and pups begin to leave the vicinity of the Pribilof Islands in mid-October; the mean departure date is in the first or second week of November. By early or mid-December, depending in part on weather conditions, most have departed.

The pups apparently scatter on leaving the islands. We assume that they travel in a southerly direction since pups have never been reported in the Bering Sea north of the Pribilof Islands. Some wander along the north side of the Alaska Peninsula and into Bristol Bay. Pups begin to appear from Bristol Bay west through the eastern Aleutian Islands in late October and early November, and most have moved into the North Pacific by early December. Pups were present off the Washington coast in January 1967 (table 26). Only two tagged pups (both males) of Pribilof Islands origin have been taken off the coast of Japan since 1958, one on 7 May 1960[22] and one on 12 March 1965.[23]

Immature males, females, and adult nonnursing females probably leave the Pribilof Islands about the same time as the nursing females and pups. Some of the immature seals are dispersed across the North Pacific Ocean throughout the year.

18 See footnote 14.

19 See footnote 16.

20 See footnote 14.

21 See footnote 13.

22 F. Nagasaki, M. Tsuboi, and K. Matsumoto. 1960. Report of Japanese fur seal research in 1960. Tokai Regional Fisheries Research Laboratory, Tokyo, 50 pp.+ figs. [Processed.]

23 Tokai Regional Fisheries Research Laboratory. 1965. Japanese pelagic investigations on fur seals, 1965. 74 pp. [Processed.]

## TAG RECOVERIES

In 1967, four tagged females and two males and two females that had lost their tags were collected (table 30). Seals that lose their tags are identified from checkmarks applied at the time of tagging.

Table 30.--Tag recoveries from fur seals collected pelagically by the United States off Washington in 1967

[Figures in parentheses indicate animals that had lost] tags; they are included in the totals.

| Age | Year of tagging | Tag series | Seals tagged | Tag recovery | | Seals collected in each age group 1/ | |
|---|---|---|---|---|---|---|---|
| | | | | ♂ | ♀ | ♂ | ♀ |
| Years | | | Number | Number | Number | Number | Number |
| 2 | 1965 | R | 30,087 | 2 | - | 5 | 3 |
| 4 | 1963 | P | 24,971 | - | 1 | 1 | 9 |
| 5 | 1962 | O | 49,908 | - | (2) | 0 | 9 |
| 6 | 1961 | N | 49,921 | - | 2 | 0 | 20 |
| 10 | 1957 | J | 49,842 | - | 1 | 0 | 11 |

1/ Table does not include seals born in years when no tagging was done, or year classes from which no tagged seals were taken.

## SIZE

Mean lengths and weights are given for pregnant and nonpregnant females collected in 1967 in tables C-9 to C-12, and for males in tables C-13 and C-14. Standard deviations are shown for samples greater than five. Mean lengths and weights of male and female fetuses collected in 1967 are shown by 10-day periods in table C-15.

## REPRODUCTION

Data on the reproductive condition of females collected at sea (table C-16) are used to relate distribution by reproductive condition to geographic areas, by time, and to determine pregnancy rates.

The youngest pregnant females taken in 1967 were one multiparous and three primiparous 5-year-old seals.

The Standing Scientific Committee of the North Pacific Fur Seal Commission (1963) has defined the term "missed pregnancy" to mean: "A female may miss pregnancy through failure to ovulate, through failure to be impregnated, or through loss of the blastocyst before implantation."

We define a missed pregnancy as one in which the animal ovulated but did not become pregnant. Animals that have no gross evidence of ovulation are classified as nonpregnant animals. The presence of a degenerating corpus luteum in an ovary of a nonpregnant animal indicates ovulation without pregnancy. Pregnancies that are terminated before implantation may not be detectable several months later. In defining reproductive condition we have no estimate of the amount of error from this cause.

An increase in the proportion of missed pregnancies would suggest that the population was subjected to increasing stress from some cause. Table 31 shows missed pregnancies in females collected in 1967.

Table 32 shows the number of female seals (and percentage pregnant) taken in the eastern Pacific Ocean from 1958 to 1967 and table C-17 those taken off Washington in 1967. Pregnancy

Table 31.--Missed pregnancies in nonpregnant female seals collected in 1967

| Age | Total females collected | Pregnant females collected | Nonpregnant females | |
|---|---|---|---|---|
| | | | Total | Missed pregnancy 1/ |
| Years | Number | Number | Number | Number |
| 1 | 6 | - | 6 | - |
| 2 | 3 | - | 3 | - |
| 3 | 10 | - | 10 | - |
| 4 | 9 | - | 9 | - |
| 5 | 9 | 4 | 5 | 2 |
| 6 | 20 | 12 | 8 | 6 |
| 7 | 7 | 5 | 2 | 1 |
| 8 | 7 | 6 | 1 | 1 |
| 9 | 12 | 12 | - | - |
| 10 | 11 | 10 | 1 | 1 |
| 11 | 4 | 4 | - | - |
| 12 | 3 | 2 | 1 | 1 |
| 13 | 3 | 3 | - | - |
| 14 | 1 | 1 | - | - |
| 15 | 3 | 2 | 1 | 1 |
| 16 | 6 | 6 | - | - |
| 17 | 2 | - | 2 | 1 |
| 20 | 1 | - | 1 | - |
| 22 | 1 | - | 1 | 1 |
| Total | 118 | 67 | 51 | 15 |

1/ Determined by the presence of a corpus luteum in one ovary.

Table 32.--Number of female seals collected pelagically by the United States in the eastern Pacific and (in parentheses) percentage pregnant, 1958-67

| Age | Year | | | | | | | | | | 1958-67 combined |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1958 | 1959 | 1960 | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | |
| Years | Number | | | | | | | | | | |
| 3 | 39 (2.6) | 43 (0.0) | 18 (0.0) | 84 (0.0) | 93 (1.1) | 53 (0.0) | 74 (0.0) | 51 (0.0) | 30 (0.0) | 10 (0.0) | 495 (0.4) |
| 4 | 42 (2.4) | 93 (6.4) | 36 (2.8) | 96 (1.0) | 140 (2.9) | 113 (7.1) | 62 (1.6) | 73 (0.0) | 68 (1.5) | 9 (0.0) | 732 (3.1) |
| 5 | 70 (45.7) | 114 (56.1) | 55 (49.1) | 68 (20.6) | 123 (26.0) | 162 (43.8) | 84 (35.7) | 23 (26.1) | 66 (27.3) | 9 (44.4) | 774 (38.5) |
| 6 | 99 (80.8) | 118 (77.1) | 45 (80.0) | 62 (75.8) | 72 (54.2) | 90 (74.4) | 81 (75.3) | 37 (56.8) | 35 (71.4) | 20 (60.0) | 659 (72.7) |
| 7 | 103 (89.3) | 143 (76.2) | 66 (78.8) | 95 (75.8) | 93 (84.9) | 77 (88.3) | 44 (77.3) | 24 (79.2) | 46 (78.3) | 7 (71.4) | 698 (81.1) |
| 8 | 102 (89.2) | 164 (86.6) | 105 (85.7) | 107 (79.4) | 98 (89.8) | 87 (97.7) | 46 (84.8) | 33 (84.8) | 43 (79.1) | 7 (85.7) | 792 (86.9) |
| 9 | 81 (96.3) | 108 (88.9) | 144 (92.4) | 114 (93.9) | 73 (83.6) | 60 (85.0) | 30 (83.3) | 17 (70.6) | 20 (100.0) | 12 (100.0) | 659 (90.3) |
| 10 | 97 (87.6) | 96 (85.4) | 129 (91.5) | 112 (93.8) | 100 (89.0) | 72 (93.1) | 49 (87.8) | 10 (90.0) | 13 (84.6) | 11 (90.9) | 689 (89.8) |

Table 32.--Number of female seals collected pelagically by the United States in the eastern Pacific and (in parentheses) percentage pregnant, 1958-67--Continued.

| Age | Year | | | | | | | | | | 1958-67 combined |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1958 | 1959 | 1960 | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | |
| Years | Number | | | | | | | | | | |
| 11 | 113 (92.0) | 98 (89.8) | 136 (91.2) | 82 (89.0) | 91 (89.0) | 88 (94.3) | 42 (85.7) | 18 (83.3) | 23 (78.3) | 4 (100.0) | 695 (90.1) |
| 12 | 134 (82.0) | 76 (88.2) | 106 (90.6) | 71 (93.0) | 97 (89.7) | 92 (92.4) | 51 (84.3) | 15 (73.3) | 16 (100.0) | 3 (66.7) | 661 (88.2) |
| 13 | 110 (82.7) | 56 (89.3) | 120 (87.5) | 76 (82.9) | 58 (94.8) | 76 (90.8) | 33 (84.8) | 8 (100.0) | 12 (100.0) | 3 (100.0) | 552 (87.7) |
| 14 | 92 (81.5) | 70 (84.3) | 107 (80.4) | 67 (92.5) | 65 (87.7) | 57 (80.7) | 38 (76.3) | 10 (80.0) | 14 (85.7) | 1 (100.0) | 521 (83.5) |
| 15 | 71 (78.9) | 87 (88.5) | 67 (83.6) | 68 (79.4) | 53 (81.1) | 75 (85.3) | 41 (65.9) | 14 (78.6) | 15 (93.3) | 3 (66.7) | 494 (81.8) |
| 16 | 56 (78.6) | 69 (75.4) | 53 (71.7) | 55 (85.5) | 50 (82.0) | 45 (82.2) | 22 (72.7) | 12 (83.3) | 5 (80.0) | 6 (100.0) | 373 (79.1) |
| 17 | 36 (55.6) | 36 (80.6) | 46 (67.4) | 24 (62.5) | 44 (72.7) | 28 (71.4) | 21 (61.9) | 10 (80.0) | 5 (40.0) | 2 (0.0) | 252 (67.5) |
| 18 | 22 (59.1) | 27 (85.2) | 23 (82.6) | 25 (64.0) | 25 (72.0) | 12 (58.3) | 20 (60.0) | 8 (37.5) | - - | - - | 162 (68.5) |
| 19 | 14 (28.6) | 16 (81.3) | 19 (57.9) | 10 (50.0) | 15 (60.0) | 5 (60.0) | 7 (57.1) | 2 (0.0) | 3 (33.3) | - - | 91 (54.9) |
| 20 | 3 (33.3) | 5 (40.0) | 6 (16.7) | 7 (100.0) | 11 (72.7) | 11 (45.5) | 10 (20.0) | 2 (0.0) | 1 (0.0) | 1 (0.0) | 57 (45.6) |
| 21 | 1 (100.0) | 7 (85.7) | 6 (50.0) | 2 (50.0) | 3 (100.0) | 4 (50.0) | - - | 1 (0.0) | 1 (0.0) | - - | 25 (64.0) |
| 22 | 1 (0.0) | 5 (40.0) | - - | - - | 3 (66.7) | - - | - - | - - | - - | 1 (0.0) | 10 (40.0) |
| 23 | - - | 1 (0.0) | 1 (0.0) | 1 (0.0) | - - | 2 (0.0) | 1 (100.0) | 1 (0.0) | - - | - - | 7 (14.3) |
| 24 | - - | 1 (0.0) | 1 (0.0) | 1 (0.0) | 1 (0.0) | - - | - - | - - | - - | - - | 4 (0.0) |
| 26 | - - | 1 (0.0) | - - | - - | - - | - - | - - | - - | - - | - - | 1 (0.0) |
| Total | 1,286 (76.1) | 1,434 (73.8) | 1,289 (79.7) | 1,227 (68.5) | 1,308 (63.4) | 1,209 (69.3) | 756 (58.7) | 369 (45.8) | 416 (52.3) | 109 (61.5) | 9,403 (68.9) |
| 6-26 years | 1,135 (83.3) | 1,184 (83.4) | 1,180 (84.4) | 979 (84.3) | 952 (83.2) | 881 (86.0) | 536 (77.0) | 222 (73.4) | 252 (81.3) | 81 (77.8) | 7,402 (83.1) |

rates of seals collected off Washington, and those of the combined pelagic collections, vary in the different year classes. The sample sizes are small, however, and the differences are probably not significant.

Pregnancy occurs in the left and right uterine horn with about equal frequency. Of 67 pregnant females collected in 1967, 33 were pregnant in the left uterine horn and 34 in the right.

The sex ratio among fetuses is about equal in data combined for all years (1958-66) (U.S. Fish and Wildlife Service, Bureau of Commercial Fisheries, 1969). In 1967, the 66 fetuses taken included 28 males and 38 females.

## ATTACHED ORGANISMS (COMMENSALS)

All seals collected since 1965 have been examined for gooseneck barnacles and algae. Records through 1966 are summarized in "Fur seal investigations, 1966" (U.S. Fish and Wildlife Service, Bureau of Commercial Fisheries, 1969). No gooseneck barnacles or algae were found attached to the fur of 131 seals collected off Washington in 1967 (80 in January and 51 in February).

## FOOD

Fur seals feed on a variety of fish and cephalopods in the eastern and western North Pacific Ocean, Bering Sea, Sea of Okhotsk, and Sea of Japan (Lucas, 1899; Scheffer, 1950; Taylor, Fujinaga, and Wilke, 1955; Wilke and Kenyon, 1957; Fiscus et al., 1964; North Pacific Fur Seal Commission, 1965; Fiscus et al., 1965; and Fiscus and Kajimura, 1965; 1967).

Fur seals are usually found offshore on or near the edge of the Continental Shelf, where they feed on the most readily available schooling fishes and squids. Fur seals feed principally between dusk and dawn; however, they may also feed during the day.

Food items found in fur seal stomachs were identified by comparing them with reference collection specimens and by using identification keys prepared by Berry (1912; 1914); Sasaki (1929); Schultz (1936); Clothier (1950); Clemens and Wilby (1961); Clarke (1962); and Akimushkin (1963).

### STOMACH CONTENTS OF FUR SEALS TAKEN OFF WASHINGTON

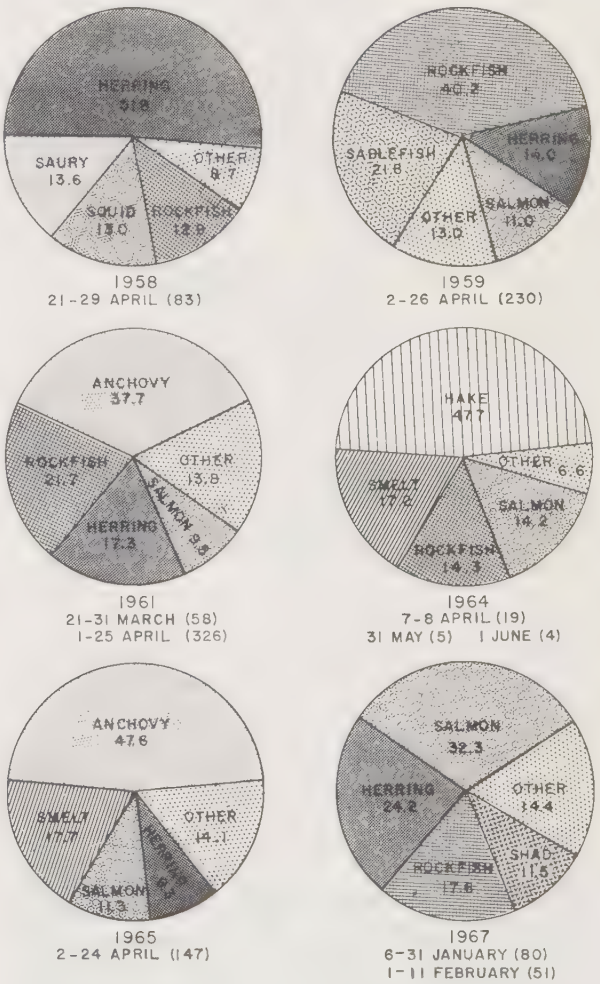
The number of fur seal stomachs examined from Washington waters since 1958 is 1,001. Yearly totals were:

| 1958 | 1959 | 1961 | 1964 | 1965 | 1967 |
|---|---|---|---|---|---|
| 83 | 230 | 382 | 28 | 147 | 131 |

During these years 80 percent (799) of the fur seals collected off Washington were taken in April; 57 percent (about 570) of the stomachs contained food. Figure 15 shows the four food species eaten in greatest volume.

Table 33 gives the stomach contents of fur seals collected off Washington in 1967. Sixty-eight percent of the stomachs contained food. Salmonidae, herring, rockfish, shad, and anchovy made up 96.6 percent of the total food volume. Salmonidae contributed 32.3 percent and herring 24.2 percent. The remains of shrimp were found for the first time in two stomachs.

Where applicable, the common and scientific names of fish are from a list published by the American Fisheries Society (1960), and names of cephalopods are those used by Berry (1912; 1914) and Sasaki (1929).




The following fishes and cephalopods were identified:

Alosa sapidissima. A minor food of fur seals off Washington, American shad ranked fourth in total food volume in 1967 (fig. 16) and were found in seven stomachs. Previous occurrences were: one in 1959; eight in 1961 (contributed 5.1 percent of total food volume); and one in 1964.

Table 33.--Stomach contents of fur seals collected pelagically by the United States off Washington in 1967[1/]

| Food | Winter January-February | | |
|---|---|---|---|
| | Volume | | Frequency |
| | Cc. | Percent | Number |
| Fish | | | |
| Alosa sapidissima | 3,728 | 11.5 | 7 |
| Clupea harengus pallasi | 7,806 | 24.2 | 15 |
| Engraulis mordax | 3,550 | 11.0 | 8 |
| Salmonidae | 10,437 | 32.3 | 18 |
| Mallotus villosus | 5 | 0.0 | 3 |
| Thaleichthys pacificus | 62 | 0.2 | 5 |
| Merluccius productus | 99 | 0.3 | 2 |
| Sebastodes spp. | 5,675 | 17.6 | 5 |
| Anoplopoma fimbria | 140 | 0.4 | 1 |
| Unidentified | T | 0.0 | 20 |
| Squid | | | |
| Loligo opalescens | 750 | 2.3 | 47 |
| Onychoteuthis sp. | T | 0.0 | 3 |
| Gonatidae | 75 | 0.2 | 14 |
| Gonatus fabricii | T | 0.0 | 2 |
| Pebbles | T | 0.0 | 6 |
| Isopoda | T | 0.0 | 1 |
| Crustacea | 10 | 0.0 | 3 |
| Total | 32,337 | | |
| Stomachs with food | 89 | | |
| Stomachs empty | 42 | | |

1/ T=trace (<5 cc.). Trace counts are included in frequency counts.

Clupea harengus pallasi. Pacific herring have been one of four leading food species in 5 of the 6 years that collections were made off Washington. They were second in importance in 1967 (15 occurrences--see fig. 16), and contributed 24.2 percent of the total food volume.

Engraulis mordax. Northern anchovies were eaten by fur seals collected during 5 of the 6 years off the Washington coast since 1958. They ranked fifth in total food volume in 1967, and first in 1961 and 1965. Northern anchovies were found in the same general locality in 1961, 1965, and 1967 (fig. 17).

Salmonidae. Salmon occur with greater frequency in the stomachs of fur seals taken off Washington than in those from other areas. Collectively, the five Pacific salmon have been among the four leading kinds of fish eaten by fur seals in 5 of the 6 years that collections have been made off Washington. Salmonids ranked fifth in total frequency of occurrence in 1958-67.

The proportion of food volume contributed by salmon has remained nearly constant since 1958, occurring in 138 (1.5 percent) of 9,364 stomachs examined from all areas. Off Washington, salmon were found in 61 (6.1 percent) of 1,001 stomachs examined and in 10.7 percent of stomachs containing food.

In 1967, salmon ranked first in total food volume (fig. 15) and were found in 18 of 131 stomachs (fig. 17). All five species of Pacific

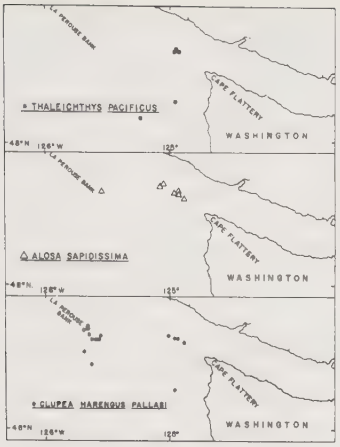



Figure 16.--Locations where fur seal stomachs collected off Washington in 1967 contained Thaleichthys pacificus (5 occurrences), Alosa sapidissima (7 occurrences), and Clupea harengus pallasi (15 occurrences).

salmon (Oncorhynchus gorbuscha, O. keta, O. kisutch, O. nerka, and O. tshawytscha) and steelhead trout, Salmo gairdneri, were identified.[24] One stomach contained the remains of O. gorbuscha, O. kisutch, O. tshawytscha, and Salmo gairdneri. All species except O. gorbuscha were immature, their scales showing 1, 2, and 3 years of ocean growth. The O. gorbuscha were 2 years of age and would be mature.

Mallotus villosus. Capelin are a minor food of seals off Washington, although important in Alaskan waters. Capelin were in the stomachs of three seals collected in 1967, the first since 1961 when six seals taken off Grays Harbor contained capelin.

Thaleichthys pacificus. Eulachon were a minor food in 1967. Three of five occurrences were from seals taken 18.5 km. (10 miles) off Cape Flattery, Wash. (fig. 16). Eulachon ranked second in food volume in 1964 and 1965.

Merluccius productus. Pacific hake have also been a minor food off Washington. Remains of this fish were found in the stomachs of two seals, one taken at lat. 48°29' N., long. 124°56' W. and another at lat. 48°13' N., long. 124°57' W. In the small sample taken off Washington in 1964, however, this species ranked first in food volume.

Sebastodes spp. Rockfishes have been one of the four leading food items eaten by fur seals in 5 of the 6 years when samples were collected. They ranked first in total food volume

[24] Salmon scales were identified by Kenneth H. Mosher and Gunnar Safsten, BCF Biological Laboratory, Seattle, Wash.

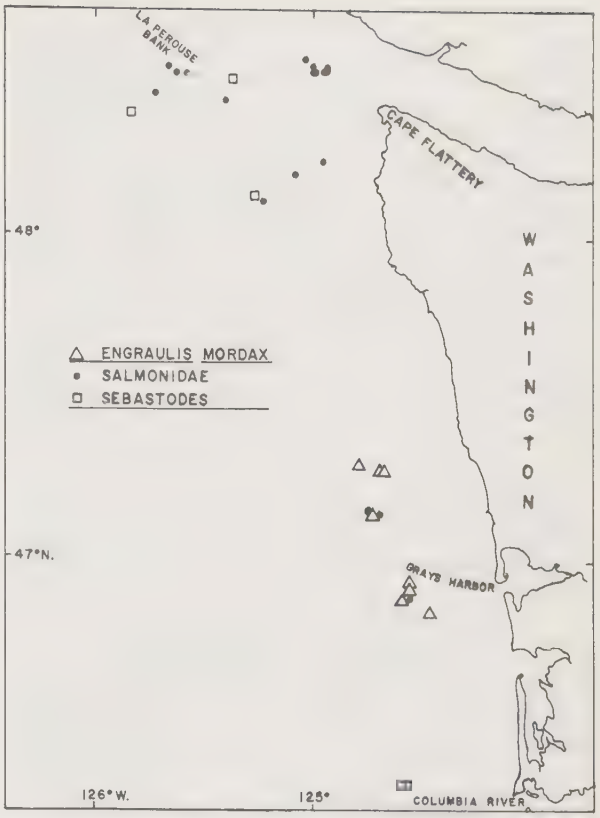



Figure 17.--Locations where fur seal stomachs collected off Washington in 1967 contained Engraulis mordax (8 occurrences), Salmonidae (18 occurrences), and Sebastodes spp. (5 occurrences).

in 1959 and third in 1967. In 1967, rockfishes were found in the stomachs of two seals taken off the Columbia River and of three seals taken west of Cape Flattery (fig. 17). Rockfishes were also the major food of seals collected off Washington by Canadian investigators in 1958[25] and 1960.[26]

Anoplopoma fimbria. Sablefishes, often called "blackcod" by commercial fishermen, are a minor food of fur seals off Washington, although in 1959 they ranked second in total volume. They were found in only one stomach in 1967, which was collected about 19 km. (10 nautical miles) off Cape Flattery, Wash. (lat. 48°29' N., long. 124°56' W.).

[25] G. C. Pike, D. J. Spalding, I. B. MacAskie, and F. P. J. Velsen. 1958. Preliminary report on Canadian pelagic fur seal research in 1958. Fisheries Research Board of Canada, Nanaimo, B.C., 76 pp. + appendixes. [Processed.]

[26] G. C. Pike, D. J. Spalding, I. B. MacAskie, and A. Craig. 1960. Report on Canadian pelagic fur seal research in 1960. Fisheries Research Board of Canada, Nanaimo, B.C., 67 pp. + appendixes. [Processed.]

Squids. Squids are one of the major foods of the fur seal throughout its range. Loligo opalescens, Onychoteuthis sp., and Gonatus fabricii, together, were the main food of fur seals off Washington by frequency of occurrence during January and February 1967. (Onychoteuthis banksii and O. boreali japonicus were until recently considered synonymous. Evidence now indicates that both may be valid species. Until this question is resolved specimens of Onychoteuthis can be identified to genus only.) Squid bodies are quickly digested, frequently leaving only the beaks and pens. Therefore, squids usually rank high in frequency of occurrence and low in percentage of total volume.

Loligo opalescens. These squids are the major species eaten by fur seals off the Washington coast. In 1967, most were in stomachs of seals taken in less than 183 m. (100 fathoms) of water mainly near La Perouse Bank and off Cape Flattery, Wash. (fig. 18). One seal taken at lat. 48°32' N., long. 125°39' W. contained the remains of 62 L. opalescens. The stomachs of four seals collected more than 315 km. (170 nautical miles) from the nearest land (between lat. 49°00' N., long. 131°50' W., and lat. 49°00' N., long. 132°25' W.) contained beaks of L. opalescens.

Onychoteuthis sp. These squids were found in the stomachs of three fur seals from lat. 48°29' N., long. 124°56' W.; lat. 47°40' N., long. 125°03' W.; and lat. 47°15' N., long. 124°46' W. They are a minor food species in Washington waters.

Gonatus fabricii. These squids are also a minor food of fur seals off Washington. Two occurrences in 1967 were from a seal taken in less than 183 m. (100 fathoms) of water, at lat. 48°28' N., long. 124°53' W., and another in water of over 2,743 m. (1,500 fathoms), at lat. 49°00' N., long. 131°50' W.

Squids in 14 stomachs were identified as gonatids (Gonatidae), species undetermined. The stomachs of two seals, collected in deep water at lat. 49°00' N. and long. 131°50' W. and 132°17' W., contained 66 and 73 squids of the family Gonatidae.

Miscellaneous objects found in fur seal stomachs in 1967 were: pebbles in five stomachs, one of which contained 354 (largest size 1.7 X 2.6 cm.); one parasitic isopod Rocinela belliceps; and three occurrences of other Crustacea (two shrimp and one crab). One seal taken at lat. 47°17' N., long. 124°47' W. had the remains of 12 shrimp and another taken at lat. 49°00' N., long. 132°17' W. had remains of one shrimp. These are the first records of shrimp in fur seal stomachs.

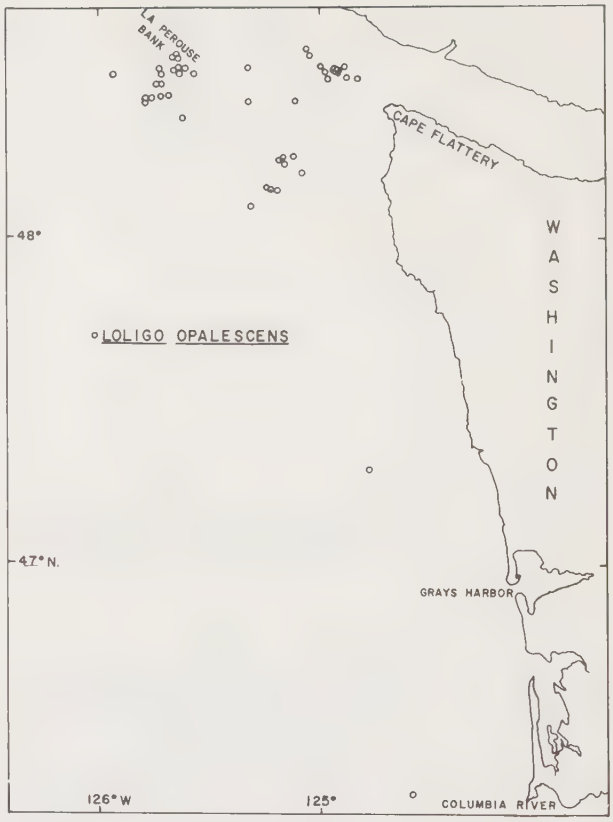



Figure 18.--Locations where fur seal stomachs collected off Washington in 1967 contained Loligo opalescens (47 occurrences).

## INGESTION OF MARINE ORGANISMS BY PUPS

The food and feeding habits of adult and subadult fur seals are generally well known from extensive pelagic research conducted from 1958 through 1967 by Canada, Japan, the U.S.S.R., and the United States under terms of the Interim Convention on Conservation of North Pacific Fur Seals. The food of pups immediately before and after their departure from the Pribilof Islands, however, has been studied little. This section summarizes the information available on the latter subject and presents a study of the food of 20 pups collected on St. Paul Island in 1966.

Several investigators have suggested that the pups are wholly dependent on milk until they leave the islands in autumn. According to Lucas (1899), 13 of 22 stomachs examined by Clark on St. Paul Island from 29 August to 20 October 1896 contained milk, 7 were empty, and 2 contained crustaceans. Lucas concluded that the pups feed exclusively on milk before migrating south. Scheffer (1950) stated that the pups are less likely to learn to catch fish before weaning and that they change abruptly

from a milk to a fish diet. Peterson[27] observed that about 50 percent of the females and their young departed from the rookery on the same day, and that 10 percent of the pups left before and 40 percent after the females. C. H. Fiscus examined the stomach contents of two pups collected by E. T. Lyons on 6 October 1961 from Polovina Rookery, St. Paul Island. The stomach of a large female pup contained two Pacific sandfish, Trichodon trichodon; vertebrae from three unidentified fish; one otolith from a walleye pollock, Theragra chalcogrammus; the remains of an invertebrate; shell fragments from a mollusk; a trace of seaweed; and 20 pebbles up to 6 by 10 mm. in size. An acanthocephalan was found in the ileocaecal junction of this animal. The stomach of the other pup contained two gammarid amphipods. According to Abegglen, Roppel, Johnson, and Wilke,[28] the stomach of a male pup taken 13 October 1961 from Polovina Rookery contained about 30 gammarid amphipods and the stomach of another collected on Little Polovina Rookery 27 October 1961 contained smelt (Osmeridae). Since milk was not found in the stomachs examined by Fiscus and by Abegglen et al., these pups had been weaned or were feeding on marine animals between nursings.

The food of 20 pups (10 each from Zapadni Reef and Northeast Point Rookeries) collected on St. Paul Island 14 - 15 November 1966 was identified in the stomach contents and 1-g. fecal samples from the small intestine of each (table 34). The gastrointestinal tracts of nine contained either marine organisms or parasites transmittable only by fish. The stomach of one animal contained a fish otolith, the apparent remains of the intestinal lining of fish were found in four, nine contained milk, and six were empty. Nine of the 20 fecal samples contained marine organisms, indicating that the pups had fed at sea before leaving St. Paul Island (a similar ratio was noted among 15 pups collected off the coast of Washington in January and February 1967). Fecal samples from three pups contained ascarids; one sample also contained acanthocephalans.[29] Because ascarids and acanthocephalans require fish as an intermediate host, these three pups had obviously fed on fish.

The theory that northern fur seal pups change their diet abruptly from milk to fish and feed on fish for the first time upon leaving the rookery islands in autumn has never been investigated. A comparison of fecal material and stomach contents from the same animal has shown that the latter are not completely reliable in establishing whether a pup has or has not begun to feed on fish or squid (field number 110, table 34). A fecal sample negative for marine organisms is also unreliable because food passes through the animal rather quickly. For example, nearly half the pups taken off the coast of Washington in January and February of 1967 had no remains of marine organisms in their stomachs. The stomachs of 9 of the 20 pups collected on St. Paul Island in November of 1966 contained 62 to 1,290 ml. of milk. Pups that are nursing or digesting a large meal of milk probably do not forage.

It is not possible to judge from this sample of 20 stomachs how important to survival is the feeding by nursing pups on marine organisms.

## RELATION OF FUR SEALS TO COMMERCIAL FISHERIES

Although the fur seal feeds on a variety of commercially important species of fish and cephalopods throughout its range, its effect on commercially important species is impossible to assess with present knowledge of ocean ecology.

Fur seals are occasionally caught in drift gill nets used by the Bureau of Commercial Fisheries in research on salmon; however, they seldom damage the nets. Seals have been observed taking salmon out of gill nets (D. Craddock, Fishery Research Biologist, BCF Biological Laboratory, Seattle, personal communication, 28 September 1967). The experience of Japanese high-seas salmon fishermen is assumed to be similar to that of U.S. research vessels fishing gill nets.

Salmon have occurred in 6 percent of 1,001 stomachs collected off Washington since 1958, and in 11 percent of the 570 stomachs containing food. Since 1958, 1.5 percent (138) of 9,364 stomachs from all areas contained salmon.

Damage to fishing gear and stocks of Pacific halibut, Hippoglossus stenolepsis, is almost nil. The damage reported by halibut fishermen has been done by Steller sea lions Eumetopias jubata (E. Best, Fishery Biologist, International Halibut Commission, Seattle, Wash., personal communication, 28 September 1967). Pacific halibut have been found in only two fur seal stomachs from thousands examined. Halibut weighing 5 pounds (2.2 kg.) or more (legal size) are plentiful around the Pribilof Islands.

[27] See footnote 17.

[28] Carl E. Abegglen, Alton Y. Roppel, Ancel M. Johnson, and Ford Wilke. 1961. Fur seal investigations, Pribilof Islands, Alaska. Report of field activities June-November 1961. BCF Marine Mammal Biological Laboratory, Seattle, Wash., 149 pp. [Processed.]

[29] Acanthocephalans identified by M. C. Keyes.

Table 34.--Stomach and intestinal contents of pups collected on St. Paul Island, 14-15 November 1966

| Field number | 0930 | 1030 | 1040 | 101 | 108 | 109 | 110 | 112 | 114 | 1115 | 102 | 103 | 104 | 105 | 106 | 107 | 111 | 113 | 115 | 116 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sex | F | F | F | F | F | F | F | F | F | M | M | M | M | M | M | M | M | M | M | M |
| Length (cm.) | 78.5 | 78.0 | 81.5 | 78.7 | 79.3 | 79.8 | 80.0 | 80.2 | 74.3 | 72.4 | 83.0 | 76.0 | 79.5 | 80.5 | 76.0 | 82.0 | 87.3 | 80.0 | 82.5 | 78.0 |
| Weight (kg.) | 15.0 | 14.5 | 13.7 | 14.5 | 15.0 | 13.5 | 15.0 | 13.5 | 11.0 | 9.0 | 15.0 | 12.5 | 14.0 | 13.0 | 12.0 | 17.0 | 14.0 | 12.5 | 15.0 | 10.5 |
| Stomach contents | | | | | | | | | | | | | | | | | | | | |
| Fish remains[1/] | - | - | i | - | i | - | - | - | - | i | - | - | - | - | - | i | o | - | - | - |
| Milk (cc.)[2/] | - | 1,240 | 800 | - | 845 | 270 | 155 | 1,135 | 830 | - | - | 62 | - | - | - | - | - | - | 1,290 | - |
| Pebbles | X | - | X | - | X | X | X | - | - | - | X | X | - | - | - | X | X | - | X | - |
| Organic matter[3/] | X | - | - | - | - | - | - | - | - | - | X | - | - | - | - | - | X | - | X | - |
| Barnacle fragments | - | - | - | - | - | X | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Gastropoda shell fragments | - | - | - | - | - | X | - | - | - | - | - | - | - | - | - | X | - | - | - | - |
| Euphausiids | X | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Unknown | X | - | - | - | - | X | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Empty | - | - | - | 4/ X | - | - | - | - | - | - | - | - | 4/ X | 4/ X | X | - | - | X | - | X |
| Intestinal contents[5/] | | | | | | | | | | | | | | | | | | | | |
| Fish remains | e | - | - | - | - | - | v | - | - | - | e | - | e, o | s, v | v | e | e, o, v | - | - | v |
| Milk | - | - | - | - | - | ? | - | - | - | - | - | - | - | X | - | - | - | - | - | - |
| Pebbles | - | - | - | - | - | - | - | - | - | - | - | - | X | - | - | X | - | - | - | - |
| Euphausiids | X | - | - | - | - | - | - | - | - | - | - | - | - | - | - | X | X | - | - | - |
| Empty | - | X | X | X | X | X | - | X | X | X | - | X | - | - | - | - | - | X | X | - |

1/ Fish remains include following: v=vertebrae and spines; s=skull; o=otolith; e=eye lens; i=intestinal lining of fish?
2/ Stomachs containing milk represent 100 percent of contents, other items in stomachs represent trace amounts only.
3/ Organic matter includes kelp and wood.
4/ Round worms present in stomach.
5/ One gram of intestinal matter examined from each pup.

# OBSERVATIONS OF JAPANESE PELAGIC FUR SEAL RESEARCH

The provisions under "Article II, Paragraph 5, of the Interim Convention on Conservation of North Pacific Fur Seals" encourage the exchange of scientific personnel between member Parties subject to mutual consent of the Parties directly concerned. Under this provision, a U.S. biologist, Hiroshi Kajimura, went to Japan in April and May 1967, to observe Japanese pelagic sealing methods. Trial methods seen were: (1) Attempted selection of animals by size and sex; (2) use of .30 caliber rifles instead of shotguns to collect seals; (3) attempted improvement of information on loss among seals shot at sea; and (4) changes in preliminary handling of skins aboard the vessel and on shore before the skins are shipped to the processor.

The headquarters of biologists studying fur seals are at the Tokai Regional Fisheries Research Laboratory, Tokyo. (It was moved to Shimizu in 1967.) Pelagic fur seal research data are analyzed at a field station in Ozuchi (Akahama), a small fishing village in Iwate Prefecture (fig. 19).

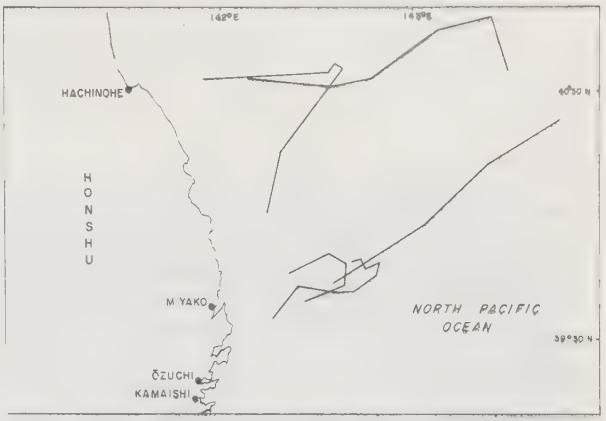



Figure 19.--Area of operation and fishing villages visited by the Tenyu Maru off northern Japan, 14 April to 10 May 1967.

## VESSELS

Two harpoon vessels, the No. 3 Hachiman Maru,[30] and No. 5 Tenyu Maru,[31] (fig. 20), were chartered by the Japanese Government in 1967 for pelagic fur seal research from 8 January to 31 May 1967. Austin and Wilke (1950), Tanonaka (1958),[32] and Kajimura (1967) have described these vessels, or "tsukimbosen."

The two ships were nearly identical except that the Hachiman Maru had a pilothouse with wheel amidships and a wooden tiller attached directly to the rudder; the Tenyu Maru had a pilothouse aft but only a wooden tiller (fig. 21). These wooden tillers on both vessels were used for steering while sealing. Vessels respond to such a tiller more quickly than to a tiller moved by a conventional steering wheel located amidships--a distinct advantage when following an animal that changes direction rapidly.

The 12-man crew on each vessel included a captain (who is usually the chief hunter), engineer, boatswain, radio operator, cook, and seven others who are both fishermen and deckhands. A field investigator was also aboard the vessel to collect and record biological data.

## AREA OF OPERATIONS

Japan carried out fur seal research off Iwate and Aomori Prefectures, north of Ozuchi between lat. 39°20' N. and 40°50' N. and offshore to long. 143°50' E. (fig. 19) from 15 April to 9 May.

## OBSERVATIONS

The range of these relatively small harpoon vessels is limited to about 185 km. (100 nautical miles) per day. Seals were usually hunted 19 to 93 km. (10-50 nautical miles) offshore. The vessels left port each morning between 1:00 a.m. and 4:00 a.m., depending on the area to be covered, and entered a harbor each night. They drifted offshore only when the sea was calm.

To watch for seals, the hunters and lookouts stood on the harpooning and shooting platform supported by the bowsprit. The captains guided their vessels into water with surface temperatures of 7° to 10° C., because it is here that fur seals are usually most abundant off the northern coast of Honshu Island during April and May. Water temperatures were read directly from a dial-type gauge mounted in the pilothouse.

The vessel approached a seal at full speed if the animal was moving away from the vessel. A resting or sleeping seal was approached slowly and quietly (fig. 22). Two hunters stationed on the shooting platform used either single- or double-barrelled 12-

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[30] No. 3 Hachiman Maru; length 18.3 m. (60.1 ft.), 34.14 metric tons, 180 hp., cruising speed 15 km. per hour (8 knots).

[31] No. 5 Tenyu Maru; length 18.1 m. (59.3 ft.), 29.95 metric tons, 120 hp., cruising speed 15 km. per hour (8 knots).

[32] George K. Tanonaka. 1958. A report on Japanese Pelagic Sealing Research Methods and Techniques in 1958. BCF Marine Mammal Biological Laboratory, Seattle, Wash., 53 pp. [Processed.]

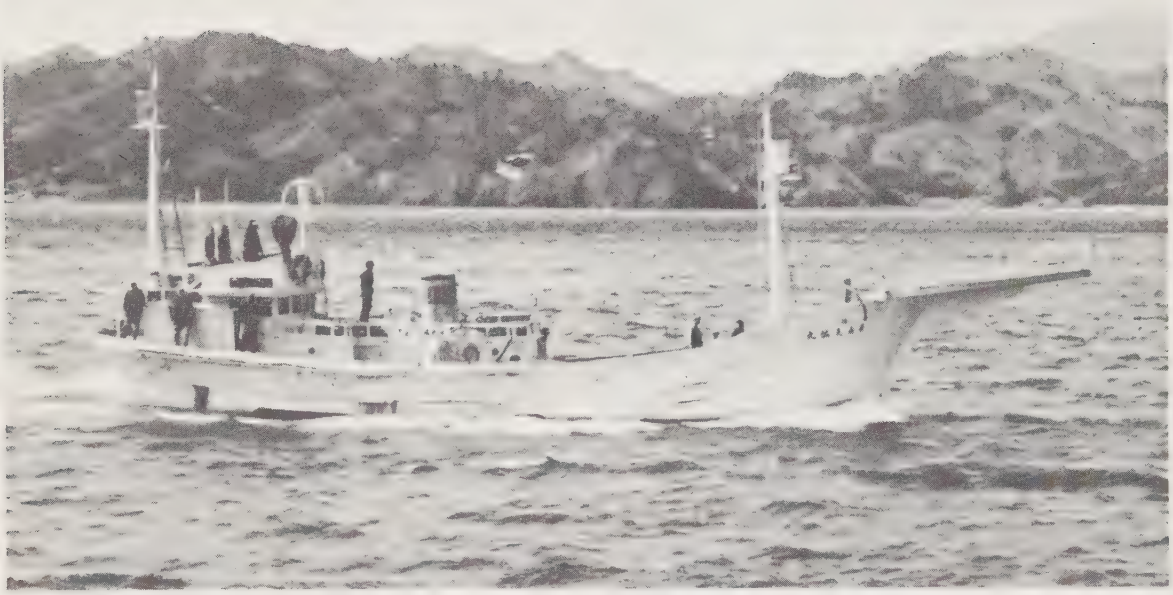

Figure 20.--Tenyu Maru, Japanese vessel used for pelagic fur seal research in 1967.

gauge shotguns loaded with 00 buckshot. The chief hunter stood forwardmost on the bow platform; the second hunter stood behind him on the side nearest the seal.

Arm signals to the helmsman (usually by the lookout standing behind the gunners) directed the movement of the vessel during the hunting (fig. 23). The helmsman in turn signaled the engineroom for changes in speed and in the forward-reverse movement of the vessel. The hunters had to be surefooted, since the shin-high railing on the bow platform offered little protection for anyone who lost his balance. In addition, vibration of the engine shook the bow platform moderately to violently and made shooting very difficult.

A 5.5-m. (18-foot) bamboo pole with a 4-prong gaff on one end and a line attached to the other was used to recover seals at sea. The retrieving pole was first thrown over the seal and then dragged over it to hook into the skin. The speed of the vessel was usually reduced during recovery of a seal.

The long experience of the crew working as a unit has contributed much to the successful use of these vessels for pelagic sealing. Except in 1966, the Hachiman Maru has been chartered for fur seal research each year since 1960. The Tenyu Maru has been chartered each year since 1961.

While the U.S. biologist was aboard the Tenyu Maru from 23 April to 9 May, 599 seals were sighted, 123 were collected, 11 were killed and lost, and 1 was wounded and lost (table 35). The largest number of seals sighted from this vessel in a day was 260 on 4 May (219 were sighted between 9:00 a.m. and 1:00 p.m.) between lat. 40°46' N., long. 143°09' E. and lat. 40°33' N., long. 142°34' E. No attempt was made to collect seals during this period. Four seals were collected before 9:00 a.m. and eight seals were taken after 3:20 p.m. Because seals feed at night or at dusk, they were usually collected early or late in the day to increase the probability of finding food in the stomachs.

The largest collection observed was on 9 May when 43 seals were taken. Most were collected by midday from Hachinohe east to lat. 40°35' N., long. 142°39' E. As many seals as possible were collected because the vessel was scheduled to return to Ozuchi that night. Seal carcasses could be sold in Ozuchi for experimental medicinal and cosmetic products.

One hundred and seven seals were taken with 12-gauge shotguns loaded with 00 buckshot

Figure 21.--Helmsman at tiller of the Tenyu Maru.

Figure 22.--Hunter giving arm signals to helmsman as the Tenyu Maru quietly approaches a resting seal.

and 16 were shot with a .30-caliber rifle (table 35). The rifle was used primarily to compare the relative effectiveness of high-velocity bullets and low-velocity 00 buckshot. Injury to a seal hit by a rifle bullet was severe enough to slow its movement. It could then be pursued and collected more easily. Generally, a seal shot with buckshot had many small holes in its skin. An entrance hole made by one rifle bullet was comparable to that made by one 00 buckshot. The exit hole made by a rifle bullet, however, was as large as 7.5 cm. (3 inches) in diameter, whereas that made by one 00 buckshot was about equal to its entrance hole.

The proportion of seals that have been shot from these ships and killed and lost (sunk) has been relatively low because (1) harpoon vessels can be turned quickly to pick up dead seals, (2) seals are hunted only during favorable weather, and (3) the crew is very efficient because it has worked as a unit for many years. Seals killed and lost were usually those that sank immediately after being shot, before the vessel could be brought within gaffing distance of the seals.

## FIELD DATA

Data taken for each fur seal collected included the time the seal was sighted and brought aboard the vessel; number of seals in the group; behavior (swimming or sleeping); and air and surface water temperatures.

The seals were weighed (fig. 24) and measured, and the sex of each was recorded. Stomachs were cut out after removal of the skin, and an identifying number was attached to each before it was preserved in a solution of 10 percent formalin. (The stomachs were not injected with formalin to stop digestive actions as they are treated aboard United States research vessels.) Upper and lower canine teeth were preserved, either by collecting the whole skull or by cutting off the upper and lower jaws. The genital tracts of females were preserved in a solution of 10-percent formalin for examination in the laboratory.

## SKIN HANDLING

The seals were skinned completely with a knife rather than stripped (fig. 25). A longitudinal cut was made from the tip of the

Figure 23.--Vessel approaching sleeping seals.

lower jaw to the tail, and another was made around each flipper. The skin was then removed, and an identifying number was attached. Workers left only a small amount of blubber or flesh on each skin and were careful to avoid making cuts or flay marks.

The seamen washed and cooled the skins by towing them alongside the vessel (fig. 26). Standard procedure has been to tie a line through the eye and armholes and tow the skins anterior end forward for a short period of time. In 1967, some of the skins were towed posterior end forward (a line was tied through the eye hole as a safety precaution) to determine if this method improved the initial handling of raw skins aboard the vessels. The Japanese biologist reasoned that the skins would be washed and cooled better from the furred side if towed so the water ran against rather than with the lay of the fur. The results of the experiment are unknown to us.

When thoroughly washed and cooled in sea water, the skins were placed in a saturated solution of salt for 12 hours or longer (usually until the following morning). The "waterlogged" skins were removed from the brine, and each was placed on a fleshing beam where the water (brine solution) was pressed out (fig. 27). The skins were then salted.

Skins unloaded at the home port of Ozuchi were shipped immediately to the processing plant in Tokyo. All skins in the hold were removed and placed on the dock. Agents from the processing firm salted, folded, and packaged the skins, five to a plastic bag that in turn was put in a burlap bag (figs. 28 and 29).

Table 35. --Total seals sighted, collected, killed and lost, and wounded and lost by Tenyu Maru, 23 April to 9 May 1967

| Date | Area of operation | Seals sighted | Seals collected | | Seals killed and lost | | Seals wounded and lost |
|---|---|---|---|---|---|---|---|
| | | | Shotgun | Rifle | Shotgun | Rifle | |
| | | Number | Number | Number | Number | Number | Number |
| April | | | | | | | |
| 23 | 39°32' N., 142°23' E. | 1 | - | - | - | - | - |
| 25 | (39°42' N., 142°30' E. (39°50' N., 142°50' E. | 76 | 35 | - | 3 | - | - |
| 27 | 39°45' N., 142°35' E. | 47 | 6 | 10 | 2 | - | - |
| 29 | 39°45' N., 142°25' E. | 13 | 3 | - | 1 | - | - |
| May | | | | | | | |
| 3 | (39°51' N., 142°51' E. (40°25' N., 143°48' E. | 94 | 11 | - | 1 | - | - |
| 4 | (40°36' N., 143°30' E. (40°34' N., 142°07' E. | 260 | 15 | - | 1 | - | - |
| 9 | (40°34' N., 142°34' E. (40°35' N., 142°39' E. (40°15' N., 142°19' E. | 108 | 37 | 6 | 2 | 1 | 1 |
| Total | | 599 | 107 | 16 | 10 | 1 | 1 |

Figure 24.--Fur seal being weighed with graduated beam scale.

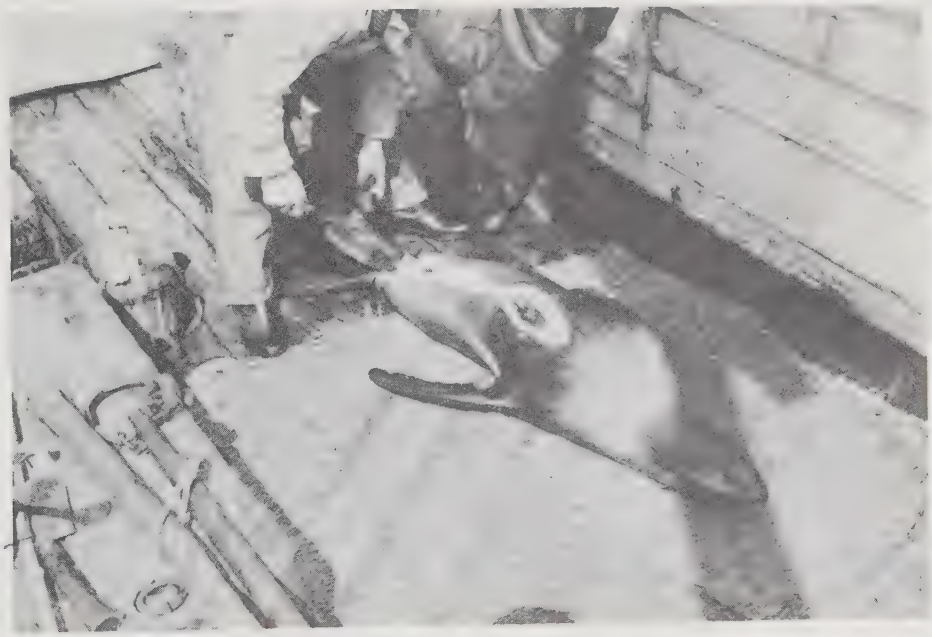

Figure 25.--Skinning fur seal aboard the Tenyu Maru.

Each bundle was tied, labeled, and otherwise prepared for the 2-day journey by unrefrigerated truck. Blubber and flesh still on the skins were removed in the processing plant (figs. 30 and 31).

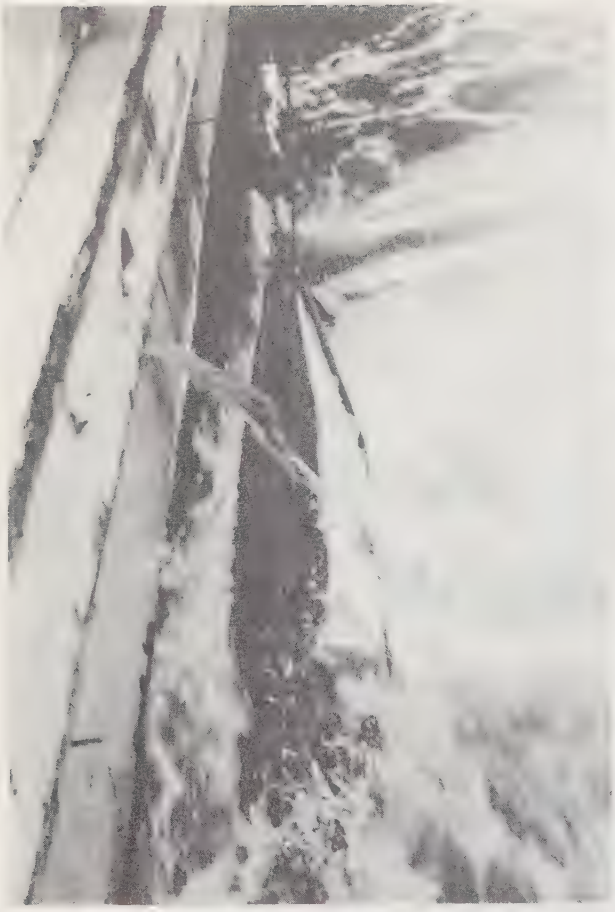

Figure 26.--Washing and cooling fur seal skin.

Figure 27.--Pressing brine water from sealskin before salting.

Figure 28.--Sealskins being salted and folded before packaging in plastic and burlap bags.

Figure 29.--Bundled sealskins ready for shipping to processing plant.

Figure 30.--Removal of blubber from sealskin at processing plant. (Note buckshot damage to skin.)

Figure 31.--Sealskin with blubber removed.

## SUMMARY

The 10th year of pelagic fur seal research required by the Interim Convention on Conservation of North Pacific Fur Seals was conducted off Washington from 6 January through 12 February 1967.

The Bureau of Commercial Fisheries Pribilof Islands supply vessel, M/V Pribilof, and the chartered vessel, M/V Tonquin, were used in the research. The Pribilof was used to survey offshore Washington waters extending seaward 769 km. (415 nautical miles), and the Tonquin was used to collect seals close to shore.

Most seals were within 111 km. (60 nautical miles) of land. Seals were collected off Cape Flattery and westward to La Perouse Bank in January and February. They were common on the Continental Shelf from Grays Harbor northward towards Umatilla Reef in early February.

Of 835 seals sighted off Washington, 131 were collected, 27 were wounded and lost, and 21 were killed and lost.

More young seals were taken off Washington during January and February 1967 than off California during the same period in 1966.

Two fur seals were seen off northern California during three cruises covering a distance of 4,425 km. (2,388 nautical miles) and 280 hours of observations off northern California in September and off Washington and Oregon in August and September 1967.

A research cruise in the Bering Sea off the Pribilof Islands to Unalaska and Unimak Pass continued from 20 November to 4 December 1966. Of 32 seals sighted, 1 was collected, 1 was wounded and lost, and 1 was killed and lost.

Four tagged seals, two that had lost tags, and two that were marked as pups by removing part of a flipper, were taken in 1967.

The youngest gravid females taken were one multiparous and three primiparous 5-year-old seals. Fifty-seven percent of the female seals were gravid.

Of 66 fetuses taken in 1967, 38 were females and 28 were males.

No gooseneck barnacles or algae were attached to the fur of seals taken in 1967.

Salmonidae (32.3 percent) and herring (24.2 percent) contributed over half the total food volume. The remains of shrimp were found for the first time by the United States in two fur seal stomachs.

Gastrointestinal contents and parasites showed that 45 percent of a collection of 20 pups from St. Paul Island had fed on marine organisms in November while still nursing.

No satisfactory assessment of the effect of fur seals on commercially important marine species is possible.

A United States observer spent April and May at the Japanese fur seal research base in Iwate Prefecture. During this period research workers saw 599 fur seals, collected 123, and lost 11 that sank and 1 that was wounded.

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## APPENDIX A

Table A-1.--Age classification of male seals killed on St. Paul Island, 27 June to 5 August 1967

| Date | Rookery[1] | Males killed | Tooth sample | Seals in each age group of sample | | | | | Estimated seals killed from each age group | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 2 | 3 | 4 | 5 | 6 | 2 | 3 | 4 | 5 | 6 |
| June | | Number | Number | Percent | | | | | Number | | | | |
| 27 | TZR | 828 | 152 | 0.7 | 42.1 | 51.3 | 5.2 | 0.7 | 6 | 348 | 425 | 43 | 6 |
| 28 | ZAP | 846 | 165 | 0.6 | 52.7 | 36.3 | 9.7 | 0.7 | 5 | 446 | 307 | 82 | 6 |
| 29 | REEF | 799 | 152 | 2.0 | 40.1 | 52.0 | 5.3 | 0.6 | 16 | 320 | 416 | 42 | 5 |
| 30 | NEP(east) | 767 | 151 | 3.3 | 45.0 | 49.7 | 1.3 | 0.7 | 25 | 345 | 382 | 10 | 5 |
| 30 | NEP(west) | 405 | 76 | 1.3 | 40.8 | 54.0 | 3.9 | - | 5 | 165 | 219 | 16 | - |
| July | | | | | | | | | | | | | |
| 1 | POL | 470 | 92 | 2.2 | 50.0 | 41.3 | 5.4 | 1.1 | 10 | 235 | 195 | 25 | 5 |
| 1 | L-K | 306 | 53 | - | 39.6 | 50.9 | 9.5 | - | - | 121 | 156 | 29 | - |
| 5 | ZAP | 1,240 | 228 | 0.9 | 69.3 | 28.1 | 1.7 | - | 11 | 860 | 348 | 21 | - |
| 6 | TZR | 430 | 77 | - | 54.5 | 39.0 | 6.5 | - | - | 234 | 168 | 28 | - |
| 6 | POL | 448 | 85 | 1.2 | 60.0 | 35.3 | 3.5 | - | 5 | 269 | 158 | 16 | - |
| 7 | NEP(east) | 1,103 | 210 | 3.8 | 57.2 | 37.6 | 1.4 | - | 42 | 631 | 415 | 15 | - |
| 7 | NEP(west) | 302 | 56 | - | 58.9 | 35.7 | 5.4 | - | - | 178 | 108 | 16 | - |
| 8 | REEF | 386 | 71 | 1.4 | 57.8 | 35.2 | 5.6 | - | 5 | 223 | 136 | 22 | - |
| 8 | L-K | 516 | 103 | 2.9 | 63.1 | 31.1 | 1.9 | 1.0 | 15 | 326 | 160 | 10 | 5 |
| 10 | ZAP | 1,428 | 276 | 2.9 | 65.6 | 30.1 | 1.4 | - | 41 | 937 | 430 | 20 | - |
| 11 | TZR | 280 | 56 | 3.6 | 55.3 | 39.3 | 1.8 | - | 10 | 155 | 110 | 5 | - |
| 11 | POL | 575 | 110 | 2.7 | 52.8 | 40.9 | 3.6 | - | 15 | 304 | 235 | 21 | - |
| 12 | NEP(east) | 798 | 145 | 3.4 | 73.8 | 19.4 | 3.4 | - | 27 | 589 | 155 | 27 | - |
| 12 | NEP(west) | 548 | 108 | 6.5 | 68.6 | 23.1 | 1.8 | - | 36 | 376 | 126 | 10 | - |
| 13 | REEF | 1,019 | 180 | 1.7 | 65.0 | 30.5 | 2.8 | - | 17 | 663 | 311 | 28 | - |
| 14 | ZAP | 1,021 | 206 | 3.4 | 52.4 | 40.8 | 2.9 | 0.5 | 35 | 535 | 416 | 30 | 5 |
| 15 | TZR | 739 | 142 | 7.7 | 57.8 | 30.3 | 4.2 | - | 57 | 427 | 224 | 31 | - |
| 15 | POL | 318 | 60 | 3.3 | 53.4 | 40.0 | 3.3 | - | 10 | 170 | 128 | 10 | - |
| 17 | NEP(east) | 1,271 | 238 | 8.4 | 65.1 | 24.0 | 2.5 | - | 107 | 827 | 305 | 32 | - |
| 17 | NEP(west) | 329 | 58 | 3.4 | 62.1 | 29.3 | 5.2 | - | 11 | 205 | 96 | 17 | - |
| 18 | REEF | 835 | 154 | 0.6 | 59.8 | 36.4 | 2.6 | 0.6 | 5 | 499 | 304 | 22 | 5 |
| 18 | L-K | 1,049 | 219 | 5.0 | 66.3 | 26.0 | 2.7 | - | 52 | 695 | 274 | 28 | - |
| 19 | ZAP | 2,898 | 501 | 5.0 | 60.7 | 31.1 | 3.2 | - | 145 | 1,759 | 901 | 93 | - |
| 20 | TZR | 78 | 17 | - | 35.3 | 47.1 | 17.6 | - | - | 28 | 37 | 13 | - |
| 20 | POL | 375 | 82 | 1.2 | 67.1 | 28.1 | 1.2 | 2.4 | 4 | 252 | 106 | 4 | 9 |
| 21 | NEP(east) | 811 | 183 | 3.3 | 74.4 | 20.2 | 1.6 | 0.5 | 27 | 603 | 164 | 13 | 4 |
| 21 | NEP(west) | 564 | 125 | 4.0 | 64.8 | 28.0 | 3.2 | - | 23 | 365 | 158 | 18 | - |
| 22 | REEF | 734 | 128 | 5.5 | 61.7 | 25.8 | 6.2 | 0.8 | 40 | 453 | 189 | 46 | 6 |
| 22 | L-K | 343 | 102 | 2.0 | 64.7 | 29.4 | 3.9 | - | 7 | 222 | 101 | 13 | - |
| 24 | ZAP | 1,515 | 304 | 5.3 | 70.4 | 21.7 | 2.6 | - | 80 | 1,067 | 329 | 39 | - |
| 25 | TZR | 426 | 71 | 1.4 | 73.3 | 23.9 | 1.4 | - | 6 | 312 | 102 | 6 | - |
| 25 | POL | 914 | 154 | 2.6 | 61.7 | 33.8 | 1.9 | - | 24 | 564 | 309 | 17 | - |
| 26 | NEP(east) | 1,715 | 343 | 15.2 | 63.8 | 19.3 | 1.7 | - | 261 | 1,094 | 330 | 30 | - |
| 26 | NEP(west) | 517 | 108 | 4.6 | 64.8 | 28.7 | 1.9 | - | 24 | 335 | 148 | 10 | - |
| 27 | REEF | 1,243 | 250 | 3.2 | 70.8 | 22.4 | 2.8 | 0.8 | 40 | 880 | 278 | 35 | 10 |
| 27 | L-K | 444 | 91 | 7.7 | 72.5 | 18.7 | 1.1 | - | 34 | 322 | 83 | 5 | - |
| 28 | ZAP | 1,439 | 442 | 5.9 | 67.4 | 23.3 | 3.2 | 0.2 | 85 | 970 | 335 | 46 | 3 |
| 29 | TZR | 775 | 168 | 4.2 | 61.9 | 29.2 | 4.7 | - | 33 | 480 | 226 | 36 | - |
| 29 | POL | 766 | 196 | 5.6 | 72.0 | 20.9 | 1.0 | 0.5 | 43 | 551 | 160 | 8 | 4 |
| 31 | NEP(east) | 961 | 263 | 14.1 | 68.0 | 17.5 | 0.4 | - | 136 | 653 | 168 | 4 | - |
| 31 | NEP(west) | 242 | 57 | 14.0 | 71.9 | 12.3 | 1.8 | - | 34 | 174 | 30 | 4 | - |
| Aug. | | | | | | | | | | | | | |
| 1 | REEF | 1,216 | 371 | 7.8 | 73.6 | 15.1 | 3.5 | - | 95 | 895 | 184 | 42 | - |
| 1 | L-K | 521 | 82 | 11.0 | 71.9 | 14.7 | 2.4 | - | 57 | 375 | 77 | 12 | - |
| 2 | ZAP | 902 | 269 | 5.6 | 76.2 | 14.1 | 3.0 | 1.1 | 51 | 687 | 127 | 27 | 10 |
| 3 | TZR | 382 | 73 | - | 68.5 | 26.0 | 4.1 | 1.4 | - | 262 | 99 | 16 | 5 |
| 3 | POL | 322 | 114 | 7.0 | 70.2 | 20.2 | 2.6 | - | 23 | 226 | 65 | 8 | - |
| 4 | NEP(east) | 433 | 140 | 15.7 | 70.7 | 12.9 | 0.7 | - | 68 | 306 | 55 | 4 | - |
| 4 | NEP(west) | 350 | 92 | 9.8 | 68.5 | 18.4 | 3.3 | - | 34 | 240 | 65 | 11 | - |
| 4 | POL | 582 | 166 | 8.4 | 74.7 | 15.7 | 1.2 | - | 49 | 435 | 91 | 7 | - |
| 5 | REEF | 853 | 218 | 10.1 | 78.5 | 6.9 | 4.1 | 0.4 | 86 | 670 | 59 | 35 | 3 |
| 5 | L-K | 324 | 80 | 17.5 | 71.3 | 10.0 | 1.2 | - | 57 | 231 | 32 | 4 | - |
| 5 | ZAP | 658 | 131 | 10.0 | 75.6 | 10.6 | 3.8 | - | 66 | 497 | 70 | 25 | - |
| Season total | | 42,359[2] | 8,944 | | | | | | 2,200 | 26,991 | 11,785 | 1,287 | 96 |

1/ NEP(east)=east or Morjovi side of Northeast Point; NEP(west)=west or Vostochni side of Northeast Point; TZR=Tolstoi, Zapadni Reef, and Little Zapadni; POL=Polovina and Little Polovina; ZAP=Zapadni; REEF=Reef, Gorbatch, and Ardiguen; L-K=Lukanin and Kitovi.

2/ Does not include 368 males taken during the kill of females, 8-15 August.

Table A-2.--Cumulative age classification of male seals killed on St. Paul Island, 27 June to 5 August 1967

| Date | Rookery[1] | Estimated seals killed from each age group | | | | | Total kill | Seals in each age group of sample | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2 | 3 | 4 | 5 | 6 | | 2 | 3 | 4 | 5 | 6 |
| | | Number | | | | | | Percent | | | | |
| June | | | | | | | | | | | | |
| 27 | TZR | 6 | 348 | 425 | 43 | 6 | 828 | 0.7 | 42.1 | 51.3 | 5.2 | 0.7 |
| 28 | ZAP | 11 | 794 | 732 | 125 | 12 | 1,674 | 0.7 | 47.4 | 43.7 | 7.5 | 0.7 |
| 29 | REEF | 27 | 1,114 | 1,148 | 167 | 17 | 2,473 | 1.1 | 45.0 | 46.4 | 6.8 | 0.7 |
| 30 | NEP(east) | 52 | 1,459 | 1,530 | 177 | 22 | 3,240 | 1.6 | 45.0 | 47.2 | 5.5 | 0.7 |
| 30 | NEP(west) | 57 | 1,624 | 1,749 | 193 | 22 | 3,645 | 1.6 | 44.6 | 47.9 | 5.3 | 0.6 |
| July | | | | | | | | | | | | |
| 1 | POL | 67 | 1,859 | 1,944 | 218 | 27 | 4,115 | 1.6 | 45.2 | 47.2 | 5.3 | 0.7 |
| 1 | L-K | 67 | 1,980 | 2,100 | 247 | 27 | 4,421 | 1.5 | 44.8 | 47.5 | 5.6 | 0.6 |
| 5 | ZAP | 78 | 2,840 | 2,448 | 268 | 27 | 5,661 | 1.4 | 50.2 | 43.2 | 4.7 | 0.5 |
| 6 | TZR | 78 | 3,074 | 2,616 | 296 | 27 | 6,091 | 1.3 | 50.5 | 42.9 | 4.9 | 0.4 |
| 6 | POL | 83 | 3,343 | 2,774 | 312 | 27 | 6,539 | 1.3 | 51.1 | 42.4 | 4.8 | 0.4 |
| 7 | NEP(east) | 125 | 3,974 | 3,189 | 327 | 27 | 7,642 | 1.6 | 52.0 | 41.7 | 4.3 | 0.4 |
| 7 | NEP(west) | 125 | 4,152 | 3,297 | 343 | 27 | 7,944 | 1.6 | 52.3 | 41.5 | 4.3 | 0.3 |
| 8 | REEF | 130 | 4,375 | 3,433 | 365 | 27 | 8,330 | 1.6 | 52.5 | 41.2 | 4.4 | 0.3 |
| 8 | L-K | 145 | 4,701 | 3,593 | 375 | 32 | 8,846 | 1.6 | 53.2 | 40.6 | 4.2 | 0.4 |
| 10 | ZAP | 186 | 5,638 | 4,023 | 395 | 32 | 10,274 | 1.8 | 54.9 | 39.2 | 3.8 | 0.3 |
| 11 | TZR | 196 | 5,793 | 4,133 | 400 | 32 | 10,554 | 1.8 | 54.9 | 39.2 | 3.8 | 0.3 |
| 11 | POL | 211 | 6,097 | 4,368 | 421 | 32 | 11,129 | 1.9 | 54.8 | 39.2 | 3.8 | 0.3 |
| 12 | NEP(east) | 238 | 6,686 | 4,523 | 448 | 32 | 11,927 | 2.0 | 56.0 | 37.9 | 3.8 | 0.3 |
| 12 | NEP(west) | 274 | 7,062 | 4,649 | 458 | 32 | 12,475 | 2.2 | 56.6 | 37.3 | 3.7 | 0.2 |
| 13 | REEF | 291 | 7,725 | 4,960 | 486 | 32 | 13,494 | 2.2 | 57.2 | 36.8 | 3.6 | 0.2 |
| 14 | ZAP | 326 | 8,260 | 5,376 | 516 | 37 | 14,515 | 2.2 | 56.9 | 37.0 | 3.6 | 0.3 |
| 15 | TZR | 383 | 8,687 | 5,600 | 547 | 37 | 15,254 | 2.5 | 57.0 | 36.7 | 3.6 | 0.2 |
| 15 | POL | 393 | 8,857 | 5,728 | 557 | 37 | 15,572 | 2.5 | 56.9 | 36.8 | 3.6 | 0.2 |
| 17 | NEP(east) | 500 | 9,684 | 6,033 | 589 | 37 | 16,843 | 3.0 | 57.5 | 35.8 | 3.5 | 0.2 |
| 17 | NEP(west) | 511 | 9,889 | 6,129 | 606 | 37 | 17,172 | 3.0 | 57.6 | 35.7 | 3.5 | 0.2 |
| 18 | REEF | 516 | 10,388 | 6,433 | 628 | 42 | 18,007 | 2.9 | 57.7 | 35.7 | 3.5 | 0.2 |
| 18 | L-K | 568 | 11,083 | 6,707 | 656 | 42 | 19,056 | 3.0 | 58.2 | 35.2 | 3.4 | 0.2 |
| 19 | ZAP | 713 | 12,842 | 7,608 | 749 | 42 | 21,954 | 3.2 | 58.5 | 34.7 | 3.4 | 0.2 |
| 20 | TZR | 713 | 12,870 | 7,645 | 762 | 42 | 22,032 | 3.2 | 58.4 | 34.7 | 3.5 | 0.2 |
| 20 | POL | 717 | 13,122 | 7,751 | 766 | 51 | 22,407 | 3.2 | 58.6 | 34.6 | 3.4 | 0.2 |
| 21 | NEP(east) | 744 | 13,725 | 7,915 | 779 | 55 | 23,218 | 3.2 | 59.1 | 34.1 | 3.4 | 0.2 |
| 21 | NEP(west) | 767 | 14,090 | 8,073 | 797 | 55 | 23,782 | 3.2 | 59.3 | 33.9 | 3.4 | 0.2 |
| 22 | REEF | 807 | 14,543 | 8,262 | 843 | 61 | 24,516 | 3.3 | 59.4 | 33.7 | 3.4 | 0.2 |
| 22 | L-K | 814 | 14,765 | 8,363 | 856 | 61 | 24,859 | 3.3 | 59.4 | 33.7 | 3.4 | 0.2 |
| 24 | ZAP | 894 | 15,832 | 8,692 | 895 | 61 | 26,374 | 3.4 | 60.0 | 33.0 | 3.4 | 0.2 |
| 25 | TZR | 900 | 16,144 | 8,794 | 901 | 61 | 26,800 | 3.4 | 60.2 | 32.8 | 3.4 | 0.2 |
| 25 | POL | 924 | 16,708 | 9,103 | 918 | 61 | 27,714 | 3.4 | 60.3 | 32.8 | 3.3 | 0.2 |
| 26 | NEP(east) | 1,185 | 17,802 | 9,433 | 948 | 61 | 29,429 | 4.0 | 60.5 | 32.1 | 3.2 | 0.2 |
| 26 | NEP(west) | 1,209 | 18,137 | 9,581 | 958 | 61 | 29,946 | 4.0 | 60.6 | 32.0 | 3.2 | 0.2 |
| 27 | REEF | 1,249 | 19,017 | 9,859 | 993 | 71 | 31,189 | 4.0 | 61.0 | 31.6 | 3.2 | 0.2 |
| 27 | L-K | 1,283 | 19,339 | 9,942 | 998 | 71 | 31,633 | 4.1 | 61.1 | 31.4 | 3.2 | 0.2 |
| 28 | ZAP | 1,368 | 20,309 | 10,277 | 1,044 | 74 | 33,072 | 4.1 | 61.4 | 31.1 | 3.2 | 0.2 |
| 29 | TZR | 1,401 | 20.789 | 10,503 | 1,080 | 74 | 33,847 | 4.2 | 61.4 | 31.0 | 3.2 | 0.2 |
| 29 | POL | 1,444 | 21,340 | 10,663 | 1,088 | 78 | 34,613 | 4.2 | 61.7 | 30.7 | 3.2 | 0.2 |
| 31 | NEP(east) | 1,580 | 21,993 | 10,831 | 1,092 | 78 | 35,574 | 4.4 | 61.8 | 30.5 | 3.1 | 0.2 |
| 31 | NEP(west) | 1,614 | 22,167 | 10,861 | 1,096 | 78 | 35,816 | 4.5 | 61.9 | 30.3 | 3.1 | 0.2 |
| Aug. | | | | | | | | | | | | |
| 1 | REEF | 1,709 | 23,062 | 11,045 | 1,138 | 78 | 37,032 | 4.6 | 62.3 | 29.8 | 3.1 | 0.2 |
| 1 | L-K | 1,766 | 23,437 | 11,122 | 1,150 | 78 | 37,553 | 4.7 | 62.4 | 29.6 | 3.1 | 0.2 |
| 2 | ZAP | 1,817 | 24,124 | 11,249 | 1,177 | 88 | 38,455 | 4.7 | 62.7 | 29.3 | 3.1 | 0.2 |
| 3 | TZR | 1,817 | 24,386 | 11,348 | 1,193 | 93 | 38,837 | 4.7 | 62.8 | 29.2 | 3.1 | 0.2 |
| 3 | POL | 1,840 | 24,612 | 11,413 | 1,201 | 93 | 39,159 | 4.7 | 62.9 | 29.1 | 3.1 | 0.2 |
| 4 | NEP(east) | 1,908 | 24,918 | 11,468 | 1,205 | 93 | 39,592 | 4.8 | 63.0 | 29.0 | 3.0 | 0.2 |
| 4 | NEP(west) | 1,942 | 25,158 | 11,533 | 1,216 | 93 | 39,942 | 4.9 | 63.0 | 28.9 | 3.0 | 0.2 |
| 4 | POL | 1,991 | 25,593 | 11,624 | 1,223 | 93 | 40,524 | 4.9 | 63.2 | 28.7 | 3.0 | 0.2 |
| 5 | REEF | 2,077 | 26,263 | 11,683 | 1,258 | 96 | 41,377 | 5.0 | 63.5 | 28.3 | 3.0 | 0.2 |
| 5 | L-K | 2,134 | 26,494 | 11,715 | 1,262 | 96 | 41,701 | 5.1 | 63.6 | 28.1 | 3.0 | 0.2 |
| 5 | ZAP | 2,200 | 26,991 | 11,785 | 1,287 | 96 | [2]42,359 | 5.2 | 63.7 | 27.9 | 3.0 | 0.2 |

1/ NEP(east)=east or Morjovi side of Northeast Point; NEP(west)=west or Vostochni side of Northeast Point; TZR=Tolstoi, Zapadni Reef, and Little Zapadni; POL=Polovina and Little Polovina; ZAP=Zapadni; REEF=Reef, Gorbatch, and Ardiguen; L-K=Lukanin and Kitovi.

2/ Does not include 368 males taken during the kill of females, 8-15 August.

Table A-3.--Age classification of male seals killed on St. George Island, 26 June to 4 August 1967

| Date | Rookery[1] | Males killed | Tooth sample | Seals in each age group of sample | | | | | Estimated seals killed from each age group | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 2 | 3 | 4 | 5 | 6 | 2 | 3 | 4 | 5 | 6 |
| | | Number | Number | Percent | | | | | Number | | | | |
| June | | | | | | | | | | | | | |
| 26 | ZAP | 419 | 86 | 1.2 | 22.1 | 59.3 | 15.1 | 2.3 | 5 | 93 | 248 | 63 | 10 |
| 26 | NOR | 351 | 69 | - | 36.2 | 58.0 | 5.8 | - | - | 127 | 204 | 20 | - |
| 28 | EAST | 324 | 63 | - | 44.4 | 52.4 | 3.2 | - | - | 144 | 170 | 10 | - |
| 30 | NOR | 428 | 86 | 1.2 | 39.5 | 43.0 | 14.0 | 2.3 | 5 | 169 | 184 | 60 | 10 |
| 30 | ZAP | 118 | 24 | - | 33.3 | 58.3 | 8.4 | - | - | 39 | 69 | 10 | - |
| July | | | | | | | | | | | | | |
| 5 | EAST | 497 | 102 | 2.0 | 52.9 | 42.1 | 2.0 | 1.0 | 10 | 263 | 209 | 10 | 5 |
| 5 | NOR | 150 | 30 | - | 30.0 | 56.7 | 13.3 | - | - | 45 | 85 | 20 | - |
| 5 | STAR | 176 | 37 | - | 45.9 | 51.4 | 2.7 | - | - | 81 | 90 | 5 | - |
| 7 | NOR | 406 | 80 | 2.5 | 57.5 | 37.5 | 2.5 | - | 10 | 234 | 152 | 10 | - |
| 7 | ZAP | 140 | 28 | - | 42.8 | 35.7 | 17.9 | 3.6 | - | 60 | 50 | 25 | 5 |
| 10 | EAST | 465 | 96 | 1.0 | 56.3 | 35.4 | 6.3 | 1.0 | 5 | 262 | 164 | 29 | 5 |
| 10 | NOR | 316 | 62 | - | 54.9 | 41.9 | 3.2 | - | - | 174 | 132 | 10 | - |
| 12 | NOR | 537 | 108 | - | 63.9 | 32.4 | 3.7 | - | - | 343 | 174 | 20 | - |
| 14 | EAST | 295 | 60 | - | 63.3 | 35.0 | 1.7 | - | - | 187 | 103 | 5 | - |
| 14 | ZAP | 308 | 64 | 1.6 | 59.4 | 39.0 | - | - | 5 | 183 | 120 | - | - |
| 17 | NOR | 680 | 132 | 4.5 | 65.2 | 28.8 | 1.5 | - | 31 | 443 | 196 | 10 | - |
| 19 | EAST | 762 | 149 | 5.3 | 63.1 | 30.9 | 0.7 | - | 40 | 481 | 236 | 5 | - |
| 19 | NOR | 182 | 34 | - | 47.0 | 50.0 | 3.0 | - | - | 86 | 91 | 5 | - |
| 21 | NOR | 267 | 53 | 3.8 | 79.2 | 17.0 | - | - | 10 | 212 | 45 | - | - |
| 21 | ZAP | 261 | 52 | 5.8 | 69.2 | 21.2 | 3.8 | - | 15 | 181 | 55 | 10 | - |
| 24 | EAST | 380 | 73 | 2.7 | 69.9 | 20.5 | 5.5 | 1.4 | 10 | 266 | 78 | 21 | 5 |
| 24 | STAR | 277 | 64 | 4.7 | 59.4 | 35.9 | - | - | 13 | 165 | 99 | - | - |
| 26 | NOR | 1,033 | 208 | 9.6 | 70.2 | 20.2 | - | - | 99 | 725 | 209 | - | - |
| 28 | ZAP | 380 | 79 | 6.3 | 69.6 | 21.5 | 2.6 | - | 24 | 264 | 82 | 10 | - |
| 28 | NOR | 609 | 120 | 9.2 | 63.3 | 26.7 | 0.8 | - | 56 | 385 | 163 | 5 | - |
| 31 | EAST | 551 | 105 | 14.3 | 76.2 | 8.6 | 0.9 | - | 79 | 420 | 47 | 5 | - |
| 31 | NOR | 293 | 55 | 9.1 | 72.7 | 18.2 | - | - | 27 | 213 | 53 | - | - |
| Aug. | | | | | | | | | | | | | |
| 2 | ZAP | 131 | 29 | 13.8 | 65.5 | 17.2 | 3.5 | - | 18 | 86 | 22 | 5 | - |
| 2 | NOR | 610 | 123 | 16.2 | 72.4 | 10.6 | 0.8 | - | 99 | 441 | 65 | 5 | - |
| 4 | EAST | 306 | 65 | 10.8 | 75.4 | 12.3 | 1.5 | - | 33 | 231 | 38 | 4 | - |
| 4 | NOR | 880 | 175 | 16.6 | 70.3 | 12.0 | 1.1 | - | 146 | 619 | 105 | 10 | - |
| Season total | | [2]12,532 | 2,511 | | | | | | 740 | 7,622 | 3,738 | 392 | 40 |

[1] ZAP=Zapadni and South; EAST=East Reef and East Cliffs; NOR=North; STAR=Staraya Artil.

[2] Does not include 461 males taken during the kill of females, 7-17 August.

Table A-4.--Cumulative age classification of male seals killed on St. George Island, 26 June to 4 August 1967

| Date | Rookery[1] | Estimated seals killed from each age group | | | | | Total kill | Seals killed from each age group | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2 | 3 | 4 | 5 | 6 | | 2 | 3 | 4 | 5 | 6 |
| | | Number | | | | | | Percent | | | | |
| June | | | | | | | | | | | | |
| 26 | ZAP | 5 | 93 | 248 | 63 | 10 | 419 | 1.2 | 22.1 | 59.3 | 15.1 | 2.3 |
| 26 | NOR | 5 | 220 | 452 | 83 | 10 | 770 | 0.7 | 28.6 | 58.7 | 10.8 | 1.2 |
| 28 | EAST | 5 | 364 | 622 | 93 | 10 | 1,094 | 0.5 | 33.2 | 56.9 | 8.5 | 0.9 |
| 30 | NOR | 10 | 533 | 806 | 153 | 20 | 1,522 | 0.6 | 35.0 | 53.0 | 10.1 | 1.3 |
| 30 | ZAP | 10 | 572 | 875 | 163 | 20 | 1,640 | 0.6 | 34.9 | 53.4 | 9.9 | 1.2 |
| July | | | | | | | | | | | | |
| 5 | EAST | 20 | 835 | 1,084 | 173 | 25 | 2,137 | 0.9 | 39.1 | 50.7 | 8.1 | 1.2 |
| 5 | NOR | 20 | 880 | 1,169 | 193 | 25 | 2,287 | 0.9 | 38.5 | 51.1 | 8.4 | 1.1 |
| 5 | STAR | 20 | 961 | 1,259 | 198 | 25 | 2,463 | 0.8 | 39.0 | 51.1 | 8.1 | 1.0 |
| 7 | NOR | 30 | 1,195 | 1,411 | 208 | 25 | 2,869 | 1.0 | 41.7 | 49.2 | 7.2 | 0.9 |
| 7 | ZAP | 30 | 1,255 | 1,461 | 233 | 30 | 3,009 | 1.0 | 41.7 | 48.6 | 7.7 | 1.0 |
| 10 | EAST | 35 | 1,517 | 1,625 | 262 | 35 | 3,474 | 1.0 | 43.7 | 46.8 | 7.5 | 1.0 |
| 10 | NOR | 35 | 1,691 | 1,757 | 272 | 35 | 3,790 | 0.9 | 44.6 | 46.4 | 7.2 | 0.9 |
| 12 | NOR | 35 | 2,034 | 1,931 | 292 | 35 | 4,327 | 0.8 | 47.0 | 44.6 | 6.8 | 0.8 |
| 14 | EAST | 35 | 2,221 | 2,034 | 297 | 35 | 4,622 | 0.8 | 48.1 | 44.0 | 6.4 | 0.7 |
| 14 | ZAP | 40 | 2,404 | 2,154 | 297 | 35 | 4,930 | 0.8 | 48.8 | 43.7 | 6.0 | 0.7 |
| 17 | NOR | 71 | 2,847 | 2,350 | 307 | 35 | 5,610 | 1.3 | 50.7 | 41.9 | 5.5 | 0.6 |
| 19 | EAST | 111 | 3,328 | 2,586 | 312 | 35 | 6,372 | 1.7 | 52.2 | 40.6 | 4.9 | 0.6 |
| 19 | NOR | 111 | 3,414 | 2,677 | 317 | 35 | 6,554 | 1.7 | 52.1 | 40.9 | 4.8 | 0.5 |
| 21 | NOR | 121 | 3,626 | 2,722 | 317 | 35 | 6,821 | 1.8 | 53.2 | 39.9 | 4.6 | 0.5 |
| 21 | ZAP | 136 | 3,807 | 2,777 | 327 | 35 | 7,082 | 1.9 | 53.8 | 39.2 | 4.6 | 0.5 |
| 24 | EAST | 146 | 4,073 | 2,855 | 348 | 40 | 7,462 | 1.9 | 54.6 | 38.3 | 4.7 | 0.5 |
| 24 | STAR | 159 | 4,238 | 2,954 | 348 | 40 | 7,739 | 2.0 | 54.8 | 38.2 | 4.5 | 0.5 |
| 26 | NOR | 258 | 4,963 | 3,163 | 348 | 40 | 8,772 | 2.9 | 56.6 | 36.0 | 4.0 | 0.5 |
| 28 | ZAP | 282 | 5,227 | 3,245 | 358 | 40 | 9,152 | 3.1 | 57.1 | 35.5 | 3.9 | 0.4 |
| 28 | NOR | 338 | 5,612 | 3,408 | 363 | 40 | 9,761 | 3.5 | 57.5 | 34.9 | 3.7 | 0.4 |
| 31 | EAST | 417 | 6,032 | 3,455 | 368 | 40 | 10,312 | 4.0 | 58.5 | 33.5 | 3.6 | 0.4 |
| 31 | NOR | 444 | 6,245 | 3,508 | 368 | 40 | 10,605 | 4.2 | 58.9 | 33.1 | 3.4 | 0.4 |
| Aug. | | | | | | | | | | | | |
| 2 | ZAP | 462 | 6,331 | 3,530 | 373 | 40 | 10,736 | 4.3 | 59.0 | 32.9 | 3.5 | 0.3 |
| 2 | NOR | 561 | 6,772 | 3,595 | 378 | 40 | 11,346 | 4.9 | 59.7 | 31.7 | 3.3 | 0.4 |
| 4 | EAST | 594 | 7,003 | 3,633 | 382 | 40 | 11,652 | 5.1 | 60.1 | 31.2 | 3.3 | 0.3 |
| 4 | NOR | 740 | 7,622 | 3,738 | 392 | 40 | [2]12,532 | 5.9 | 60.8 | 29.8 | 3.2 | 0.3 |

1/ ZAP=Zapadni and South; EAST=East Reef and East Cliffs; NOR=North; STAR=Staraya Artil.

2/ Does not include 461 males taken during the kill of females, 7-17 August.

Table A-5.--Age classification of female seals killed on St. Paul Island, 28 July to 15 August 1967

| Date | Rookery[1/] | Females killed | Tooth sample | Seals in each age group of sample | | | | | | Estimated seals killed from each age group | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 2 | 3 | 4 | 5 | 6 | 7+ | 2 | 3 | 4 | 5 | 6 | 7+ |
| | | Number | Number | Percent | | | | | | Number | | | | | |
| July | | | | | | | | | | | | | | | |
| 28 | ZAP | 107 | 28 | - | - | - | 3.6 | 10.7 | 85.7 | - | - | - | 4 | 11 | 92 |
| 29 | POL | 57 | 16 | - | - | 6.2 | 18.8 | - | 75.0 | - | - | 4 | 10 | - | 43 |
| 31 | NEP(east) | 245 | 78 | - | 2.6 | 2.6 | 14.1 | 11.5 | 69.2 | - | 6 | 6 | 35 | 28 | 170 |
| 31 | NEP(west) | 86 | 6 | - | - | - | 16.7 | - | 83.3 | - | - | - | 14 | - | 72 |
| Aug. | | | | | | | | | | | | | | | |
| 1 | REEF | 375 | 155 | - | 1.3 | 10.3 | 10.3 | 7.8 | 70.3 | - | 5 | 39 | 39 | 29 | 263 |
| 1 | L-K | 50 | 17 | - | - | 5.9 | 11.7 | - | 82.4 | - | - | 3 | 6 | - | 41 |
| 2 | ZAP | 163 | 68 | - | 1.5 | 14.7 | 13.2 | 7.4 | 63.2 | - | 2 | 24 | 22 | 12 | 103 |
| 3 | TZR | 37 | 20 | - | - | - | 10.0 | 5.0 | 85.0 | - | - | - | 4 | 2 | 31 |
| 3 | POL | 233 | 101 | - | 4.0 | 12.9 | 11.9 | 16.8 | 54.4 | - | 9 | 30 | 28 | 39 | 127 |
| 4 | NEP(east) | 237 | 117 | - | 3.4 | 19.7 | 10.2 | 13.7 | 53.0 | - | 8 | 47 | 24 | 32 | 126 |
| 4 | NEP(west) | 232 | 96 | - | 2.1 | 9.4 | 10.4 | 6.2 | 71.9 | - | 5 | 22 | 24 | 14 | 167 |
| 4 | POL | 135 | 65 | - | 10.8 | 23.1 | 20.0 | 12.3 | 33.8 | - | 14 | 31 | 27 | 17 | 46 |
| 5 | REEF | 491 | 192 | - | 3.6 | 13.0 | 14.1 | 14.1 | 55.2 | - | 18 | 64 | 69 | 69 | 271 |
| 5 | L-K | 26 | 19 | - | -- | 10.5 | 10.5 | 15.8 | 63.2 | - | - | 3 | 3 | 4 | 16 |
| 5 | ZAP | 75 | 24 | - | 4.2 | 12.5 | 4.2 | 16.6 | 62.5 | - | 3 | 9 | 3 | 13 | 47 |
| 8 | NEP(east) | 279 | 41 | - | 9.8 | 17.1 | 12.2 | 21.9 | 39.0 | - | 27 | 48 | 34 | 61 | 109 |
| 8 | NEP(west) | 644 | 205 | - | 7.8 | 16.1 | 18.1 | 14.6 | 43.4 | - | 50 | 104 | 117 | 94 | 279 |
| 9 | REEF | 558 | 153 | - | 12.4 | 13.7 | 13.1 | 15.0 | 45.8 | - | 69 | 76 | 73 | 84 | 256 |
| 9 | POL | 457 | 112 | - | 2.7 | 12.5 | 21.4 | 25.0 | 38.4 | - | 12 | 57 | 98 | 114 | 176 |
| 10 | ZAP | 966 | 255 | 0.4 | 7.4 | 16.9 | 21.6 | 7.4 | 46.3 | 4 | 71 | 163 | 209 | 72 | 447 |
| 11 | TZR | 795 | 229 | 0.4 | 17.9 | 17.9 | 16.6 | 9.2 | 38.0 | 3 | 142 | 142 | 132 | 74 | 302 |
| 14 | NEP(west) | 128 | 33 | - | 12.1 | 24.2 | 15.2 | 18.2 | 30.3 | - | 16 | 31 | 19 | 23 | 39 |
| 14 | POL | 718 | 190 | 0.5 | 12.6 | 22.6 | 19.0 | 14.2 | 31.1 | 4 | 91 | 162 | 136 | 102 | 223 |
| 15 | POL | 233 | 66 | 3.0 | 4.5 | 7.6 | 19.7 | 16.7 | 48.5 | 7 | 10 | 18 | 46 | 39 | 113 |
| Season total | | [2/]7,327 | 2,286 | | | | | | | 18 | 558 | 1,083 | 1,176 | 933 | 3,559 |

1/ NEP(east)=east or Morjovi side of Northeast Point; NEP(west)=west or Vostochni side of Northeast Point; TZR=Tolstoi, Zapadni Reef, and Little Zapadni; POL=Polovina and Little Polovina; ZAP=Zapadni; REEF=Reef, Gorbatch, and Ardiguen; L-K=Lukanin and Kitovi.

2/ Does not include 144 females killed 27 June to 27 July, nor 31 killed 29 July.

Table A-6.--Cumulative age classification of female seals killed on St. Paul Island, 28 July to 15 August 1967

| Date | Rookery | Estimated seals killed from each age group | | | | | | Total kill | Seals killed from each age group | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2 | 3 | 4 | 5 | 6 | 7+ | | 2 | 3 | 4 | 5 | 6 | 7+ |
| | | Number | | | | | | | Percent | | | | | |
| July | | | | | | | | | | | | | | |
| 28 | ZAP | - | - | - | 4 | 11 | 92 | 107 | - | - | - | 3.7 | 10.3 | 86.0 |
| 29 | POL | - | - | 4 | 14 | 11 | 135 | 164 | - | - | 2.5 | 8.5 | 6.7 | 82.3 |
| 31 | NEP(east) | - | 6 | 10 | 49 | 39 | 305 | 409 | - | 1.5 | 2.4 | 12.0 | 9.5 | 74.6 |
| 31 | NEP(west) | - | 6 | 10 | 63 | 39 | 377 | 495 | - | 1.2 | 2.0 | 12.7 | 7.9 | 76.2 |
| Aug. | | | | | | | | | | | | | | |
| 1 | REEF | - | 11 | 49 | 102 | 68 | 640 | 870 | - | 1.3 | 5.6 | 11.7 | 7.8 | 73.6 |
| 1 | L-K | - | 11 | 52 | 108 | 68 | 681 | 920 | - | 1.2 | 5.7 | 11.7 | 7.4 | 74.0 |
| 2 | ZAP | - | 13 | 76 | 130 | 80 | 784 | 1,083 | - | 1.2 | 7.0 | 12.0 | 7.4 | 72.4 |
| 3 | TZR | - | 13 | 76 | 134 | 82 | 815 | 1,120 | - | 1.2 | 6.8 | 12.0 | 7.3 | 72.7 |
| 3 | POL | - | 22 | 106 | 162 | 121 | 942 | 1,353 | - | 1.6 | 7.8 | 12.0 | 8.9 | 69.7 |
| 4 | NEP(east) | - | 30 | 153 | 186 | 153 | 1,068 | 1,590 | - | 1.9 | 9.6 | 11.7 | 9.6 | 67.2 |
| 4 | NEP(west) | - | 35 | 175 | 210 | 167 | 1,235 | 1,822 | - | 1.9 | 9.6 | 11.5 | 9.2 | 67.8 |
| 4 | POL | - | 49 | 206 | 237 | 184 | 1,281 | 1,957 | - | 2.5 | 10.5 | 12.1 | 9.4 | 65.5 |
| 5 | REEF | - | 67 | 270 | 306 | 253 | 1,552 | 2,448 | - | 2.7 | 11.0 | 12.5 | 10.4 | 63.4 |
| 5 | L-K | - | 67 | 273 | 309 | 257 | 1,568 | 2,474 | - | 2.7 | 11.0 | 12.5 | 10.4 | 63.4 |
| 5 | ZAP | - | 70 | 282 | 312 | 270 | 1,615 | 2,549 | - | 2.7 | 11.1 | 12.2 | 10.6 | 63.4 |
| 8 | NEP(east) | - | 97 | 330 | 346 | 331 | 1,724 | 2,828 | - | 3.4 | 11.7 | 12.2 | 11.7 | 61.0 |
| 8 | NEP(west) | - | 147 | 434 | 463 | 425 | 2,003 | 3,472 | - | 4.2 | 12.5 | 13.3 | 12.3 | 57.7 |
| 9 | REEF | - | 216 | 510 | 536 | 509 | 2,259 | 4,030 | - | 5.4 | 12.7 | 13.3 | 12.6 | 56.0 |
| 9 | POL | - | 228 | 567 | 634 | 623 | 2,435 | 4,487 | - | 5.1 | 12.6 | 14.1 | 13.9 | 54.3 |
| 10 | ZAP | 4 | 299 | 730 | 843 | 695 | 2,882 | 5,453 | 0.1 | 5.5 | 13.4 | 15.5 | 12.7 | 52.8 |
| 11 | TZR | 7 | 441 | 872 | 975 | 769 | 3,184 | 6,248 | 0.1 | 7.0 | 14.0 | 15.6 | 12.3 | 51.0 |
| 14 | NEP(west) | 7 | 457 | 903 | 994 | 792 | 3,223 | 6,376 | 0.1 | 7.2 | 14.2 | 15.6 | 12.4 | 50.5 |
| 14 | POL | 11 | 548 | 1,065 | 1,130 | 894 | 3,446 | 7,094 | 0.2 | 7.7 | 15.0 | 15.9 | 12.6 | 48.6 |
| 15 | POL | 18 | 558 | 1,083 | 1,176 | 933 | 3,559 | 27,327 | 0.2 | 7.6 | 14.8 | 16.1 | 12.7 | 48.6 |

1/ NEP(east)=east or Morjovi side of Northeast Point; NEP(west)=west or Vostochni side of Northeast Point; TZR=Tolstoi, Zapadni Reef, and Little Zapadni; POL=Polovina and Little Polovina; ZAP=Zapadni; REEF=Reef, Gorbatch, and Ardiguen; L-K=Lukanin and Kitovi.

2/ Does not include 144 females killed 27 June to 27 July, nor 31 killed 29 July.

Table A-7.--Age classification of female seals killed on St. George Island, 7-17 August 1967

| Date | Rookery[1] | Females killed | Tooth sample | Seals in each age group of sample | | | | | | Estimated seals killed from each age group | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 2 | 3 | 4 | 5 | 6 | 7+ | 2 | 3 | 4 | 5 | 6 | 7+ |
| Aug. | | Number | Number | Percent | | | | | | Number | | | | | |
| 7 | STAR | 281 | 100 | - | 10.0 | 21.0 | 15.0 | 14.0 | 40.0 | - | 28 | 59 | 42 | 39 | 113 |
| 9 | ZAP | 547 | 184 | - | 6.5 | 13.0 | 18.0 | 9.8 | 52.7 | - | 36 | 71 | 98 | 54 | 288 |
| 15 | NOR | 601 | 177 | - | 15.8 | 13.6 | 20.9 | 14.7 | 35.0 | - | 95 | 82 | 126 | 88 | 210 |
| 17 | STAR | 963 | 315 | 0.3 | 22.6 | 29.5 | 11.4 | 5.4 | 30.8 | 3 | 218 | 284 | 110 | 52 | 296 |
| Season total | | [2]2,392 | 776 | | | | | | | 3 | 377 | 496 | 376 | 233 | 907 |

1/ ZAP=Zapadni and South; NOR=North; STAR=Staraya Artil.

2/ Does not include 202 females killed 26 June to 4 August.

Table A-8.--Cumulative age classification of female seals killed on St. George Island, 7-17 August 1967

| Date | Rookery[1] | Estimated seals killed from each age group | | | | | | Total kill | Seals killed from each age group | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2 | 3 | 4 | 5 | 6 | 7+ | | 2 | 3 | 4 | 5 | 6 | 7+ |
| Aug. | | Number | | | | | | | Percent | | | | | |
| 7 | STAR | - | 28 | 59 | 42 | 39 | 113 | 281 | - | 10.0 | 21.0 | 14.9 | 13.9 | 40.2 |
| 9 | ZAP | - | 64 | 130 | 140 | 93 | 401 | 828 | - | 7.7 | 15.7 | 16.9 | 11.2 | 48.5 |
| 15 | NOR | - | 159 | 212 | 266 | 181 | 611 | 1,429 | - | 11.1 | 14.8 | 18.6 | 12.7 | 42.8 |
| 17 | STAR | 3 | 377 | 496 | 376 | 233 | 907 | [2]2,392 | 0.1 | 15.8 | 20.7 | 15.7 | 9.7 | 38.0 |

1/ and 2/ See footnotes for table A-7.

Table A-9.--Dead pups counted, by rookery, Pribilof Islands, Alaska, 1941 and 1948-67

| Rookery | 1941 | 1948 1/ | 1949 1/ | 1950 | 1951 | 1952 1/ | 1953 | 1954 | 1955 | 1956 | 1957 | 1958 | 1959 | 1960 | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Number | | | | | | | | | | | |
| St. Paul Island | | | | | | | | | | | | | | | | | | | | | |
| Morjovi | 933 | 20,600 | 2,600 | 3,000 | 3,592 | | 3,764 | 8,049 | 5,571 | 10,278 | 4,253 | 2,290 | 4,560 | 6,825 | 5,259 | 4,881 | 2,348 | 1,830 | 2,649 | 1,686 | 1,072 |
| Vostochni | 7,708 | | 12,966 | 13,120 | 18,450 | | 19,503 | 25,233 | 14,473 | 20,498 | 12,732 | 7,247 | 7,105 | 11,333 | 10,173 | 8,565 | 5,057 | 3,434 | 4,214 | 2,785 | 1,969 |
| Little Polovina | 292 | | 1,600 | 1,740 | 2,208 | | 2,211 | 3,852 | 2,782 | 4,443 | 1,695 | 975 | 1,597 | 2,427 | 2,415 | 2,121 | 923 | 631 | 1,132 | 449 | 233 |
| Polovina Cliffs | 2,356 | | | 3,800 | 5,580 | 2,954 | 5,451 | 6,413 | 5,964 | 8,637 | 4,425 | 1,826 | 2,586 | 3,462 | 4,576 | 2,957 | 2,160 | 1,097 | 2,856 | 809 | 825 |
| Polovina | | | 1,779 | 5,660 | 6,402 | 3,200 | 5,036 | 6,459 | 4,660 | 7,463 | 5,432 | 2,184 | 3,311 | 5,268 | 2,499 | 1,880 | 1,237 | 783 | 1,176 | 312 | 319 |
| Ardiguen | 42 | | | 170 | 242 | | 189 | 282 | 387 | 364 | 249 | 102 | 141 | 331 | 411 | 225 | 141 | 102 | 459 | 160 | 90 |
| Gorbatch | 896 | | | 2,810 | 3,559 | | 3,679 | 4,900 | 4,789 | 6,291 | 3,801 | 1,655 | 2,100 | 3,168 | 3,550 | 1,373 | 2,431 | 1,549 | 3,123 | 1,593 | 874 |
| Reef | 2,269 | | | 9,520 | 11,007 | | 13,661 | 12,959 | 15,145 | 14,399 | 11,301 | 5,550 | 6,052 | 9,664 | 10,047 | 7,897 | 5,688 | 3,000 | 7,664 | 3,562 | 2,008 |
| Kitovi | 404 | | 800 | 1,160 | 1,517 | | 1,695 | 1,669 | 2,610 | 2,892 | 1,588 | 608 | 882 | 2,006 | 2,215 | 2,081 | 881 | 462 | 2,202 | 406 | 522 |
| Lukanin | | | 635 | 770 | 712 | | 1,086 | 1,129 | 1,129 | 1,718 | 870 | 324 | 631 | 1,037 | 1,294 | 660 | 546 | 402 | 1,126 | 432 | 240 |
| Tolstoi | 1,623 | | | 4,230 | 6,033 | | 6,154 | 7,552 | 6,489 | 6,789 | 5,659 | 2,823 | 3,691 | 5,237 | 4,761 | 3,004 | 3,274 | 2,614 | 3,955 | 3,425 | 2,251 |
| Little Zapadni | 372 | | | 2,120 | 2,804 | | 2,446 | 4,979 | 3,555 | 4,611 | 2,325 | 1,312 | 1,691 | 4,148 | 3,047 | 2,399 | 2,580 | 1,101 | 2,461 | 1,634 | 1,098 |
| Zapadni Reef | 171 | | 575 | 660 | 353 | | 1,116 | 2,278 | 1,383 | 1,674 | 917 | 246 | 608 | 1,472 | 1,291 | 598 | 718 | 425 | 723 | 451 | 380 |
| Zapadni | 1,284 | | | 4,660 | 8,204 | | 12,221 | 10,424 | 6,607 | 8,650 | 6,415 | 4,045 | 5,009 | 6,450 | 6,329 | 6,627 | 4,614 | 4,172 | 5,384 | 3,710 | 2,195 |
| Counted total | 18,350 | | | 53,420 | 70,663 | | 78,212 | 96,178 | 75,544 | 98,707 | 61,662 | 31,187 | 39,964 | 62,828 | 57,867 | 45,268 | 32,598 | 21,572 | 39,124 | 21,414 | 14,076 |
| Estimated oversight 5% | 918 | | | 2,671 | 3,533 | | 3,911 | 4,809 | 3,777 | 4,935 | 3,083 | 1,559 | 1,998 | 2,946 | 2,893 | 2,263 | 1,630 | 1,079 | 1,956 | 1,071 | 704 |
| Total | 19,268 | | | 56,091 | 74,196 | | 82,123 | 100,987 | 79,321 | 103,642 | 64,745 | 32,746 | 41,962 | 65,774 | 60,760 | 47,531 | 34,228 | 22,651 | 41,080 | 22,485 | 14,780 |
| St. George Island | | | | | | | | | | | | | | | | | | | | | |
| North | | | | | | | 3,197 | 3,776 | | 6,357 | 3,942 | 1,626 | 2,653 | 3,485 | 3,883 | 2,242 | 2,525 | 792 | 1,854 | 1,561 | 971 |
| Zapadni | | | | | | | 1,272 | 1,453 | | 2,742 | 1,569 | 962 | 1,633 | 1,902 | 2,019 | 1,740 | 704 | 446 | 1,263 | 1,196 | 578 |
| East | | | | | | | 846 | 1,524 | | 2,203 | 1,064 | 616 | 664 | 1,112 | 1,347 | 504 | 502 | 272 | 676 | 764 | 201 |
| Staraya Artil | | | | | | | 3,353 | 2,903 | | 3,806 | 2,729 | 1,552 | 1,987 | 2,000 | 2,514 | 1,435 | 1,041 | 767 | 1,186 | 1,152 | 770 |
| Counted total | | | | | | | 8,668 | 9,656 | | 15,108 | 9,304 | 4,756 | 6,937 | 8,503 | 9,763 | 5,921 | 4,772 | 2,277 | 4,979 | 4,673 | 2,520 |
| Estimated oversight 5% | | | | | | | 433 | 483 | | 755 | 465 | 238 | 347 | 425 | 488 | 296 | 239 | 114 | 249 | 234 | 126 |
| Total | | | | | | | 9,101 | 10,139 | | 15,863 | 9,769 | 4,994 | 7,284 | 8,928 | 10,251 | 6,217 | 5,011 | 2,391 | 5,228 | 4,907 | 2,646 |
| Pribilof Islands total 2/ | | | | | | | 91,224 | 111,126 | | 119,505 | 74,514 | 37,740 | 49,246 | 74,702 | 71,011 | 53,748 | 39,239 | 25,042 | 46,308 | 27,392 | 17,426 |

1/ Partial counts. No counts made in 1942-47. The count in 1948 is the total for Morjovi and Vostochni Rookeries.

2/ Not included in the total are 2,228 dead pups counted on Sea Lion Rock (Sivutch Rookery) in 1966.

Table A-10.--Dead pups counted, by rookery sections, St. Paul Island, 22-25 August 1967

| Rookery | Section 1/ | | | | | | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13&14 | |
| | Number | | | | | | | | | | | | | |
| Morjovi | 391 | 117 | 34 | 235 | 119 | 176 | | | | | | | | 1,072 |
| Vostochni | 88 | 41 | 40 | 104 | 144 | 448 | 148 | 215 | 190 | 97 | 101 | 122 | 231 | 1,969 |
| Little Polovina | 87 | 146 | | | | | | | | | | | | 233 |
| Polovina Cliffs | 94 | 88 | 96 | 135 | 135 | 152 | 125 | | | | | | | 825 |
| Polovina | 255 | 64 | | | | | | | | | | | | 319 |
| Ardiguen 2/ | | | | | | | | | | | | | | 90 |
| Gorbatch | 223 | 186 | 160 | 64 | 241 | | | | | | | | | 874 |
| Reef | 187 | 178 | 200 | 247 | 145 | 190 | 389 | 199 | 105 | 107 | 61 | | | 2,008 |
| Kitovi | 3/ 93 | 16 | 134 | 134 | 145 | | | | | | | | | 522 |
| Lukanin | 90 | 150 | | | | | | | | | | | | 240 |
| Tolstoi | 137 | 154 | 141 | 137 | 327 | 379 | 322 | 654 | | | | | | 2,251 |
| Little Zapadni | 84 | 172 | 200 | 303 | 166 | 173 | | | | | | | | 1,098 |
| Zapadni Reef | 274 | 106 | | | | | | | | | | | | 380 |
| Zapadni | 144 | 347 | 337 | 462 | 269 | 227 | 262 | 147 | | | | | | 2,195 |
| Total | | | | | | | | | | | | | | 14,076 |

1/ Where possible, each rookery was divided into sections containing about 100 Class 3 males in mid-July and the sections were numbered consecutively.

2/ No numbered sections.

3/ Includes 35 dead pups counted in Amphitheater.

Table A-11.--Lesions and circumstances associated with cases of liver damage-multiple hemorrhage-perinatal complex, St. Paul Island, 1964, 1966, and 1967

| Date and study area | Pups examined | Pups affected | | Stillborn | Placenta or fresh cord attached | No bite wounds or contusions | Subcapsular hemorrhage of liver and other organs | Focal necrosis of the liver | Intraocular hemorrhage |
|---|---|---|---|---|---|---|---|---|---|
| | Number | Number | Percent | Number | Number | Number | Number | Number | Number |
| 9 July to 22 Aug. 1964 Reef Rookery | | | | | | | | | |
| Old catwalk | 109 | 6 | 5.5 | 1 | 3 | 1 | | | 1 |
| 28 June to 22 Aug. 1966 Reef Rookery | | | | | | | | | |
| Old catwalk | 164 | 5 | 3.0 | 1 | 2 | 3 | | | |
| 29 June to 15 Aug. 1967 Reef Rookery | | | | | | | | | |
| Old catwalk | 80 | 14 | | 3 | 10 | 2 | 3 | 1 | 3 |
| New catwalk | 54 | 10 | | 2 | 8 | 5 | 3 | 2 | 1 |
| Northeast Point Rookery | 98 | 16 | | 6 | 14 | 8 | 3 | 2 | 4 |
| Total | 232 | 1/ 40 | 17.2 | 11 | 32 | 15 | 9 | 5 | 8 |
| Percent | | | | 27.5 | 80.0 | 37.5 | 22.5 | 12.5 | 20.0 |

1/ Includes 33 pups affected as the primary cause and 7 as the secondary cause of death.

Table A-12.--Number of pups that died of different causes, study areas 1, 2, and 3, St. Paul Island, 29 June to 15 August 1967

| Cause of death | 29 June to 4 July | 5-11 July | 12-18 July | 19-25 July | 26 July to 1 Aug. | 2-8 Aug. | 9-15 Aug. | Totals |
|---|---|---|---|---|---|---|---|---|
| | Number | | | | | | | |
| Malnutrition..... | 3 | 13 | 8 | 24 | 15 | 3 | 6 | 72 |
| Perinatal complex..... | 5 | 8 | 13 | 7 | 0 | 0 | 0 | 33 |
| Hookworm disease..... | 0 | 0 | 1 | 13 | 13 | 5 | 5 | 37 |
| Trauma..... | 2 | 7 | 5 | 1 | 0 | 1 | 0 | 16 |
| Infection..... | 0 | 2 | 3 | 7 | 5 | 0 | 3 | 20 |
| Miscellaneous..... | 1 | 6 | 3 | 5 | 0 | 0 | 0 | 15 |
| Undetermined..... | 0 | 3 | 4 | 3 | 4 | 2 | 1 | 17 |
| Total..... | 11 | 39 | 37 | 60 | 37 | 11 | 15 | 210 |
| Unsuitable for examination | 2 | 4 | 6 | 4 | 3 | 2 | 1 | 22 |
| Total..... | 13 | 43 | 43 | 64 | 40 | 13 | 16 | 232 |
| Advanced postmortem degeneration..... | 3 | 12 | 9 | 14 | 16 | 4 | 3 | 61 |

Table A-13.--Harem and idle male seals counted in mid-July, by island, Pribilof Islands, Alaska, 1911-41 and 1943-67

| Year | St. Paul Island | | St. George Island | | Both islands | |
|---|---|---|---|---|---|---|
| | Harem | Idle | Harem | Idle | Harem | Idle |
| | Number | | | | | |
| 1911 | 1,090 | 258 | 266 | 71 | 1,356 | 329 |
| 1912 | 1,077 | 93 | 281 | 20 | 1,358 | 113 |
| 1913 | 1,142 | 77 | 261 | 28 | 1,403 | 105 |
| 1914 | 1,316 | 159 | 243 | 13 | 1,559 | 172 |
| 1915 | 1,789 | 546 | 362 | 127 | 2,151 | 673 |
| 1916 | 2,948 | 2,278 | 552 | 354 | 3,500 | 2,632 |
| 1917 | 4,166 | 2,341 | 684 | 365 | 4,850 | 2,706 |
| 1918 | 4,610 | 2,245 | 734 | 199 | 5,344 | 2,444 |
| 1919 | 4,573 | 2,158 | 585 | 81 | 5,158 | 2,239 |
| 1920 | 3,542 | 1,078 | 524 | 83 | 4,066 | 1,161 |
| 1921 | 3,443 | 711 | 466 | 36 | 3,909 | 747 |
| 1922 | 3,184 | 493 | 378 | 15 | 3,562 | 508 |
| 1923 | 3,051 | 303 | 361 | 9 | 3,412 | 312 |
| 1924 | 3,127 | 375 | 389 | 15 | 3,516 | 390 |
| 1925 | 3,103 | 283 | 423 | 28 | 3,526 | 311 |
| 1926 | 3,478 | 368 | 556 | 55 | 4,034 | 423 |
| 1927 | 3,916 | 846 | 727 | 126 | 4,643 | 972 |
| 1928 | 5,059 | 1,208 | 991 | 241 | 6,050 | 1,449 |
| 1929 | 5,998 | 1,339 | 1,189 | 294 | 7,187 | 1,663 |
| 1930 | 6,823 | 1,555 | 1,489 | 344 | 8,312 | 1,899 |
| 1931 | 7,557 | 1,519 | 1,676 | 369 | 9,233 | 1,888 |
| 1932 | 8,268 | 1,940 | 1,820 | 409 | 10,088 | 2,349 |
| 1933 | 8,334 | 1,933 | 1,879 | 408 | 10,213 | 2,341 |
| 1934 | 8,841 | 1,860 | 1,929 | 422 | 10,770 | 2,282 |
| 1935 | 9,444 | 2,082 | 2,103 | 453 | 11,547 | 2,535 |
| 1936 | 10,055 | 2,253 | - | - | - | - |
| 1937 | 10,689 | 2,516 | 2,411 | 515 | 13,100 | 3,031 |
| 1938 | 10,720 | 1,787 | - | - | - | - |
| 1939 | 9,122 | 2,616 | 1,858 | 357 | 10,980 | 2,973 |
| 1940 | 9,662 | 3,968 | 1,988 | 571 | 11,650 | 4,539 |
| 1941 | 10,089 | 5,059 | 1,942 | 396 | 12,031 | 5,455 |
| 1943 | 10,948 | 3,523 | 2,107 | 330 | 13,055 | 3,853 |
| 1944 | 11,080 | 2,539 | 2,294 | 450 | 13,374 | 2,989 |
| 1945 | 10,750 | 4,055 | 2,434 | 750 | 13,184 | 4,805 |
| 1946 | 10,566 | 3,605 | 2,430 | 611 | 12,996 | 4,216 |
| 1947 | 10,160 | 3,331 | 1,808 | 479 | 11,968 | 3,810 |
| 1948 | 10,386 | 3,400 | 1,814 | 563 | 12,200 | 3,963 |
| 1949 | 9,554 | 2,976 | 1,746 | 552 | 11,300 | 3,528 |
| 1950 | 9,442 | 3,152 | 1,959 | 574 | 11,401 | 3,726 |
| 1951 | 9,434 | 3,581 | 1,825 | 549 | 11,259 | 4,130 |
| 1952 | 9,318 | 4,717 | 1,983 | 605 | 11,301 | 5,322 |
| 1953 | 9,848 | 5,912 | 2,285 | 826 | 12,133 | 6,738 |
| 1954 | 9,906 | 6,847 | 2,228 | 1,311 | 12,134 | 8,158 |
| 1955 | 9,034 | 8,650 | 2,130 | 1,902 | 11,164 | 10,552 |
| 1956 | 9,384 | 9,016 | - | - | - | - |
| 1957 | 9,562 | 10,060 | 2,423 | 2,693 | 11,985 | 12,753 |
| 1958 | 9,970 | 9,510 | 2,619 | 3,030 | 12,589 | 12,540 |
| 1959 | 10,003 | 11,485 | 2,527 | 2,699 | 12,530 | 14,184 |
| 1960 | 10,247 | 10,407 | 2,552 | 2,630 | 12,799 | 13,037 |
| 1961 | 11,163 | 11,791 | 2,843 | 2,489 | 14,006 | 14,280 |
| 1962 | 10,332 | 9,109 | 2,342 | 2,650 | 12,674 | 11,759 |
| 1963 | 9,212 | 7,650 | 2,071 | 1,890 | 11,283 | 9,540 |
| 1964 | 9,085 | 7,095 | 1,989 | 1,489 | 11,074 | 8,584 |
| 1965 | 8,553 | 5,616 | 1,917 | 1,113 | 10,470 | 6,729 |
| 1966 | 7,974 | 5,839 | 1,974 | 1,017 | 9,948 | 6,856 |
| 1967 1/ | 7,230 | 4,439 | 1,646 | 1,268 | 8,876 | 5,707 |

1/ Harem and idle males on St. Paul Island were counted on Reef, Lukanin, Kitovi, Tolstoi, and Zapadni Reef Rookeries only, then extrapolated to produce counts representing all the rookeries.

Table A-14.--Adult male seals counted, by class[1/] and rookery section,[2/] St. Paul Island, 22-24 June 1967

| Rookery | Class of adult male | Section 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Number | | | | | | | | | | | | | | |
| Lukanin | 1 | 3 | 9 | - | - | - | - | - | - | - | - | - | - | - | - | 12 |
| | 2 | 45 | 48 | - | - | - | - | - | - | - | - | - | - | - | - | 93 |
| | 3 | 21 | 32 | - | - | - | - | - | - | - | - | - | - | - | - | 53 |
| | 4 | - | 4 | - | - | - | - | - | - | - | - | - | - | - | - | 4 |
| | 5 | 51 | - | - | - | - | - | - | - | - | - | - | - | - | - | 51 |
| Kitovi[3/] | 1 | (3) 3 | 2 | 4 | 4 | 1 | - | - | - | - | - | - | - | - | - | 17 |
| | 2 | (22) 41 | 15 | 46 | 50 | 37 | - | - | - | - | - | - | - | - | - | 211 |
| | 3 | (14) 36 | 8 | 23 | 36 | 27 | - | - | - | - | - | - | - | - | - | 144 |
| | 4 | (0) 2 | - | 1 | - | 1 | - | - | - | - | - | - | - | - | - | 4 |
| | 5 | (0) - | - | - | - | 91 | - | - | - | - | - | - | - | - | - | 91 |
| Reef | 1 | 18 | 11 | 2 | 3 | 7 | 8 | - | 14 | 2 | 5 | 2 | - | - | - | 72 |
| | 2 | 63 | 91 | 83 | 43 | 67 | 51 | 146 | 71 | 48 | 46 | 43 | - | - | - | 752 |
| | 3 | 28 | 30 | 25 | 22 | 23 | 39 | 7 | 39 | 23 | 22 | 14 | - | - | - | 272 |
| | 4 | 3 | 3 | 1 | - | - | - | - | - | - | - | 11 | - | - | - | 18 |
| | 5 | - | - | - | - | 200 | - | - | - | - | - | 41 | - | - | - | 241 |
| Gorbatch | 1 | 12 | 4 | 3 | 4 | 12 | 8 | - | - | - | - | - | - | - | - | 43 |
| | 2 | 77 | 51 | 60 | 53 | 62 | 104 | - | - | - | - | - | - | - | - | 407 |
| | 3 | 33 | 27 | 27 | 16 | 32 | 24 | - | - | - | - | - | - | - | - | 159 |
| | 4 | 9 | 1 | 1 | 4 | 10 | - | - | - | - | - | - | - | - | - | 25 |
| | 5 | 206 | - | - | 30 | - | - | - | - | - | - | - | - | - | - | 236 |
| Ardiguen[4/] | 1 | | | | | | | | | | | | | | | 6 |
| | 2 | | | | | | | | | | | | | | | 49 |
| | 3 | | | | | | | | | | | | | | | 39 |
| | 4 | | | | | | | | | | | | | | | - |
| | 5 | | | | | | | | | | | | | | | 58 |
| Morjovi[5/] | 1 | (2) 5 | 10 | 3 | 7 | 5 | 9 | - | - | - | - | - | - | - | - | 41 |
| | 2 | (27) 51 | 45 | 41 | 66 | 66 | 98 | - | - | - | - | - | - | - | - | 394 |
| | 3 | (9) 24 | 28 | 14 | 39 | 33 | 42 | - | - | - | - | - | - | - | - | 189 |
| | 4 | (0) 16 | 11 | 7 | 12 | 9 | 18 | - | - | - | - | - | - | - | - | 73 |
| | 5 | (0)249 | - | - | - | - | - | - | - | - | - | - | - | - | - | 249 |
| Vostochni | 1 | 7 | 4 | 8 | 3 | 2 | 9 | 9 | 12 | 15 | 7 | 10 | 11 | 9 | 3 | 109 |
| | 2 | 59 | 58 | 30 | 47 | 52 | 104 | 59 | 76 | 101 | 62 | 89 | 81 | 83 | 39 | 940 |
| | 3 | 24 | 19 | 17 | 16 | 17 | 30 | 24 | 37 | 27 | 17 | 23 | 37 | 31 | 14 | 333 |
| | 4 | 10 | 6 | 4 | 8 | 6 | 12 | 10 | 24 | 20 | 6 | 13 | 15 | 7 | 6 | 147 |
| | 5 | 108 | - | - | 68 | - | - | 146 | - | - | - | - | 155 | 25 | 55 | 557 |
| Little Polovina | 1 | 2 | 5 | - | - | - | - | - | - | - | - | - | - | - | - | 7 |
| | 2 | 59 | 84 | - | - | - | - | - | - | - | - | - | - | - | - | 143 |
| | 3 | 24 | 27 | - | - | - | - | - | - | - | - | - | - | - | - | 51 |
| | 4 | 10 | 17 | - | - | - | - | - | - | - | - | - | - | - | - | 27 |
| | 5 | - | 150 | - | - | - | - | - | - | - | - | - | - | - | - | 150 |
| Polovina | 1 | 10 | 17 | - | - | - | - | - | - | - | - | - | - | - | - | 27 |
| | 2 | 95 | 55 | - | - | - | - | - | - | - | - | - | - | - | - | 150 |
| | 3 | 25 | 18 | - | - | - | - | - | - | - | - | - | - | - | - | 43 |
| | 4 | 15 | 10 | - | - | - | - | - | - | - | - | - | - | - | - | 25 |
| | 5 | 185 | - | - | - | - | - | - | - | - | - | - | - | - | - | 185 |

See footnotes at end of table.

Table A-14.--Adult males counted, by class[1/] and rookery section,[2/] St. Paul Island, 22-24 June 1967--Continued

| Rookery | Class of adult male | Section 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Number | | | | | | | | | | | | | | |
| Polovina Cliffs | 1 | 2 | 1 | 1 | 5 | 11 | 3 | 15 | - | - | - | - | - | - | - | 38 |
| | 2 | 58 | 43 | 48 | 42 | 77 | 51 | 89 | - | - | - | - | - | - | - | 408 |
| | 3 | 16 | 17 | 30 | 35 | 29 | 22 | 43 | - | - | - | - | - | - | - | 192 |
| | 4 | 7 | 16 | 10 | 12 | 3 | 13 | 7 | - | - | - | - | - | - | - | 68 |
| | 5 | - | - | - | - | - | 47 | - | - | - | - | - | - | - | - | 47 |
| Tolstoi | 1 | 8 | 9 | 12 | 14 | 16 | 10 | 4 | 7 | - | - | - | - | - | - | 80 |
| | 2 | 38 | 46 | 49 | 22 | 75 | 83 | 65 | 77 | - | - | - | - | - | - | 455 |
| | 3 | 26 | 27 | 32 | 25 | 37 | 52 | 19 | 33 | - | - | - | - | - | - | 251 |
| | 4 | - | - | - | - | 6 | 15 | 3 | - | - | - | - | - | - | - | 24 |
| | 5 | - | - | - | - | - | - | - | 472 | - | - | - | - | - | - | 472 |
| Zapadni Reef | 1 | 10 | 3 | - | - | - | - | - | - | - | - | - | - | - | - | 13 |
| | 2 | 82 | 43 | - | - | - | - | - | - | - | - | - | - | - | - | 125 |
| | 3 | 30 | 22 | - | - | - | - | - | - | - | - | - | - | - | - | 52 |
| | 4 | 10 | 3 | - | - | - | - | - | - | - | - | - | - | - | - | 13 |
| | 5 | 15 | 49 | - | - | - | - | - | - | - | - | - | - | - | - | 64 |
| Little Zapadni | 1 | 7 | 5 | 13 | 13 | 3 | 1 | - | - | - | - | - | - | - | - | 42 |
| | 2 | 28 | 39 | 69 | 97 | 40 | 55 | - | - | - | - | - | - | - | - | 328 |
| | 3 | 19 | 30 | 27 | 59 | 27 | 22 | - | - | - | - | - | - | - | - | 184 |
| | 4 | - | 7 | 6 | 13 | 2 | - | - | - | - | - | - | - | - | - | 28 |
| | 5 | 28 | - | - | - | - | 92 | - | - | - | - | - | - | - | - | 120 |
| Zapadni | 1 | 8 | 14 | 10 | 8 | 6 | 15 | 12 | 1 | - | - | - | - | - | - | 74 |
| | 2 | 61 | 92 | 81 | 96 | 80 | 82 | 81 | 38 | - | - | - | - | - | - | 611 |
| | 3 | 20 | 48 | 40 | 46 | 30 | 45 | 36 | 12 | - | - | - | - | - | - | 277 |
| | 4 | - | 13 | 13 | 15 | 19 | 10 | 6 | 6 | - | - | - | - | - | - | 82 |
| | 5 | [6/](93) | - | - | - | - | - | - | 260 | - | - | - | - | - | - | 353 |

1/ Class 1 Shoreline - Full-grown males approximately age 10 and older without females but apparently with established territories at the high tide mark.

Class 2 Territorial without females - Full-grown males approximately age 10 and older without females but with established territories on the rookery.

Class 3 Territorial with females - Full-grown males approximately age 10 and older with females and established territories on the rookery.

Class 4 Back fringe - Full-grown and partly grown males approximately age 7 and older without females and territories that are found along the inland fringe of the rookery.

Class 5 Hauling ground - Full-grown and partly grown males approximately age 7 and older without females that are found on traditional hauling grounds.

Class 3 males were formerly called harem bulls, and classes 1, 2, 4, and 5 were collectively called idle bulls.

2/ In 1966, each rookery was divided into sections that contained approximately 100 Class 3 males in mid-July and the sections were numbered consecutively throughout the rookery.

3/ Numbers in parentheses are the adult males counted in Kitovi Amphitheater.

4/ No numbered sections.

5/ Numbers in parentheses are the adult males counted on Zapadni Point reef.

6/ Numbers in parentheses are the adult males counted on the second point south of sea lion neck.

Table A-15.--Adult male seals counted on Reef, Lukanin, Kitovi, Tolstoi, and Zapadni Reef Rookeries, St. Paul Island, 9-14 July 1963-67

| Rookery | Class 1/ of adult male | Year | | | | |
|---|---|---|---|---|---|---|
| | | 1963 | 1964 | 1965 | 1966 | 1967 |
| | | Number | | | | |
| Reef | | | | | | |
| | 3 | 1,310 | 1,301 | 1,179 | 1,070 | 927 |
| | 1,2,4,5 | 1,000 | 756 | 670 | 678 | 616 |
| Total | | 2,310 | 2,057 | 1,849 | 1,748 | 1,543 |
| Lukanin | | | | | | |
| | 3 | 221 | 221 | 204 | 152 | 137 |
| | 1,2,4,5 | 225 | 94 | 147 | 108 | 77 |
| Total | | 446 | 315 | 351 | 260 | 214 |
| Kitovi | | | | | | |
| | 3 | 547 | 492 | 486 | 413 | 374 |
| | 1,2,4,5 | 147 | 152 | 205 | 194 | 118 |
| Total | | 694 | 644 | 691 | 607 | 492 |
| Tolstoi | | | | | | |
| | 3 | 893 | 920 | 876 | 819 | 791 |
| | 1,2,4,5 | 728 | 508 | 394 | 441 | 283 |
| Total | | 1,621 | 1,428 | 1,270 | 1,260 | 1,074 |
| Zapadni Reef | | | | | | |
| | 3 | 248 | 212 | 221 | 203 | 180 |
| | 1,2,4,5 | 237 | 170 | 195 | 210 | 146 |
| Total | | 485 | 382 | 416 | 413 | 326 |

1/ For description of classes, see footnote 1 of table A-14, or the glossary.

Table A-16.--Adult male seals counted by class, St. George Island, June and July 1967

| Rookery | Date | Class 1/ | | | | | Total |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | |
| | | Number | | | | | |
| Zapadni | 22 June | 33 | 243 | 46 | 14 | 173 | 509 |
| South | 22 " | 85 | 191 | 100 | - | 106 | 482 |
| Staraya Artil | 22 " | 10 | 183 | 34 | - | 137 | 364 |
| East Reef | 22 " | 3 | 73 | 28 | 9 | 141 | 254 |
| East Cliffs | 22 " | 29 | 115 | 79 | - | 10 | 233 |
| North | 22 " | 46 | 373 | 194 | 40 | 312 | 965 |
| Total | | 206 | 1,178 | 481 | 63 | 879 | 2,807 |
| East Reef | 11 July | 8 | 9 | 114 | 3 | 145 | 279 |
| East Cliffs | 11 " | 44 | 23 | 225 | 2 | - | 294 |
| Staraya Artil | 11 " | 5 | 9 | 235 | 68 | 97 | 414 |
| North | 13 " | 78 | 53 | 608 | 34 | 198 | 971 |
| Zapadni | 18 " | 12 | 14 | 227 | 20 | 336 | 609 |
| South | 18 " | 34 | - | 237 | - | 76 | 347 |
| Total | | 181 | 108 | 1,646 | 127 | 852 | 2,914 |

1/ For description of classes, see footnote 1 of table A-14, or the glossary.

Table A-17. --Pups tagged and marked, Pribilof Islands, Alaska 1941, 1945, 1947-49, and 1951-67

| Year | Series | St. Paul Island | St. George Island | Location of tag | Checkmarks or marks |
|---|---|---|---|---|---|
| 1941 | USA 1-10000; | 10,000 | | Front flipper | Branded, nape of neck |
| | USA 1-1000 and | 1,000 | | ♂♂ right front and hind | Double tagged, branded |
| | USA 5001-6000 | 1,000 | | flippers; ♀♀ left front and hind flippers | nape of neck |
| 1945 | 10001-11000 (no letter prefix) | 973 | | Left front flipper | None |
| 1947 | A 1-20000 | 19,183 | | Left front flipper | 1/4" hole between 1st (big toe) and 2d digits left hind flipper |
| 1948 | B 1-19673 | 19,532 | | Left front flipper | None |
| 1949 | CS 1-20000 | 19,963 | | Left hind flipper | None |
| 1951 | D 1-1000 | 1,000 | | Right hind flipper | 1/2 left ear on 100 tagged pups removed |
| 1952 | E 1-20000 | 19,979 | | Right front flipper | Tip of 1st digit (big toe) on right hind flipper sliced off |
| 1953 | F 1-10000 | 9,990 | | Left front flipper | Tip of left front flipper sliced off |
| | G 7001-7400 | 398 | | ------do. ------ | Do. |
| 1954 | G 1-7000 | 7,000 | | Right front flipper | "V" notch near tip right front flipper |
| | G 7401-10400 | 3,000 | | ------do. ------ | Do. |
| 1955 | H 1-10000 | 49,870 | | Left front flipper | Tip of 1st digit (big toe) on left hind |
| | 10001-50000 (no letter prefix) | | | ------do. ------ | flipper sliced off |
| 1956 | I 1-10000 | | 9,894 | Right front flipper | Tip of right front flipper sliced off |
| | I 10001-50000 | 39,900 | | ------do. ------ | Do. |
| 1957 | J 1-10000 | | 9,972 | Left front flipper | "V" notch near tip left front flipper |
| | J 10001-50000 | 39,870 | | ------do. ------ | Do. |
| 1958 | K 1-10000 | | 9,994 | Right front flipper | "V" notch near tip right front flipper |
| | K 10001-50000 | 39,923 | | ------do. ------ | Do. |
| | K 10001-15000 | 5,000 | | Right and left front flippers | Double tagged plus checkmark |
| 1959 | L 1-10000 | | 9,980 | Left front flipper | Tip of left front flipper sliced off |
| | L 10001-50000 | 39,901 | | ------do. ------ | Do. |
| 1960 | M 1-12000 | | 11,992 | Right front flipper | Tip of right front flipper sliced off |
| | M 12001-60000 | 47,989 | | ------do. ------ | Do. |
| 1961 | N 1-10000 | | 9,988 | Left front flipper | "V" notch near tip left front flipper |
| | N 10001-50000 | 39,933 | | ------do. ------ | Do. |
| 1962 | O 1-10000 | | 9,980 | Right front flipper | "V" notch near tip right front flipper |
| | O 10001-50000 | 39,928 | | ------do. ------ | Do. |
| 1963 | P 1-5000 | | 4,993 | Left front flipper | Tip of left front flipper sliced off |
| | P 5001-25000 | 19,978 | | ------do. ------ | Do. |
| 1964 | Q 1-5000 | | 4,993 | Right front flipper | Tip of right front flipper sliced off |
| | Q 5001-25000 | 19,998 | | ------do. ------ | Do. |
| 1965 | R 1-10000 | 10,000 | | Left front flipper | "V" notch near tip left front flipper |
| | Marked | 10,007 | | Not tagged | "V" notch near tip right front flipper |
| | Marked | 10,080 | | ---do. --- | Tip of 1st digit (big toe) on right hind flipper sliced off |
| 1966 | S 1-2500 | | 2,499 | Left front flipper | Tip of left front flipper sliced off |
| | S 2501-12500 | 10,000 | | Right front flipper | Tip of 2d digit on right hind flipper sliced off |
| | Marked | 9,578 | | Not tagged | Tip of 3d digit on right hind flipper sliced off |
| | Marked | | 2,503 | ---do. --- | Tip of 2d dight on left hind flipper sliced off |
| 1967 | T 9-2500 | | 2,492 | Right front flipper | Tip of right front flipper sliced off |
| | T 5001-15000 | 9,980 | | ------do. ------ | Do. |

Table A-18.--Record of tags applied[1] to male seals selected as yearlings and as 2-, 3-, and 4-year-olds on the basis of body length or size, St. Paul Island, 1961-63 and 1965-67

| Age category and year | Tag numbers | | Seals tagged[2] |
|---|---|---|---|
| | | | Number |
| Yearlings[3] | | | |
| 1961 | M | 1-2,000 | 754 |
| 1962 | N | 50,001-51,000 | 929 |
| 1963 | Ø | 50,001-51,000 | 799 |
| 1965 | 1R | 1-1,000 | 991 |
| 1966 | 1S | 20,001-21,500 | 1,495 |
| 1967 | 1T | 1-1,500 | 835 |
| Ages 2-4 | | | |
| 1966 | 2S | 30,001-31,500 | 1,483 |
| 1967 | 2T | 1-1,500 | 1,220 |

1/ Each seal was double tagged; one tag was attached to each front flipper at the hairline. Some seals with tags that had been attached when they were pups were given another tag.

2/ Total number of seals tagged within the series.

3/ Male and female seals were intentionally tagged in 1961, 1962, 1963, and 1965. Only males were intentionally tagged in 1966 and 1967.

Table A-19. --Pups tagged and checkmarked, St. Paul Island, 21-27 September 1967 [1/]

| Rookery | Tag numbers (T-series) | Tags discarded | Pups marked |
|---|---|---|---|
| | | Number | Number |
| Zapadni | 5001-6100 | 6 | 1,094 |
| Zapadni Reef | 6101-6400 | 3 | 297 |
| Little Zapadni | 6401-7050 | - | 650 |
| Reef | 7051-8550<br>8701-9300 | 5 | 2,095 |
| Gorbatch | 8551-8700 | 1 | 149 |
| Polovina | 9301-9600 | - | 300 |
| Polovina Cliffs | 9601-10300 | - | 700 |
| Little Polovina | 10301-10700 | - | 400 |
| Morjovi | 10701-11500 | - | 800 |
| Vostochni | 11501-13200 | 5 | 1,695 |
| Tolstoi | 13201-14200 | - | 1,000 |
| Lukanin | 14201-14450 | - | 250 |
| Kitovi | 14451-15000 | - | 550 |
| Total | | 20 | 9,980 |

1/ Tags were attached to the rear edge of the right front flipper at the hairline; as a checkmark, 1/2-inch of the tip of the same flipper was removed.

Table A-20.--Pups tagged and checkmarked, St. George Island, 1-2 September 1967[1]

| Rookery | Tag numbers (T-series) | Tags discarded | Pups marked |
|---|---|---|---|
| | | Number | Number |
| Zapadni | 2/ 9-700 | - | 692 |
| Staraya Artil | 701-1000 | - | 300 |
| East | 1001-1500 | - | 500 |
| North | 1501-2500 | - | 1,000 |
| Total | | - | 2,492 |

1/ Tags were attached to the rear edge of the right front flipper at the hairline; as a checkmark, 1/2-inch of the tip of the same flipper was removed.

2/ Tags with numbers 1-8 were used to double tag four young male seals on North Rookery on 13 July for telemetry studies.

Table A-21.--Record of 835 yearling male seals tagged, St. Paul Island, 1967

| Rookery or hauling ground | Tag numbers (1T-series) 1/ | Effective tags |
|---|---|---|
| | | Number |
| Polovina | 1-100 | 100 |
| Reef | 201-236 | 36 |
| English Bay Sands | 401-1000 | 590 |
| Northeast Point | 1001-1109 | 108 |
| | 2T-205 | 1 |
| Total | | 835 |

1/ One tag was not in the 1T series (no. 2T-205).

Table A-22.--Record of tag identification numbers for 48 male seals tagged or marked as pups and tagged again as yearlings, St. Paul Island, 28 September to 10 October 1967

[Numbers in parentheses indicate pup tags.]

| Tagged or marked as pups by the United States and tagged again as yearlings by the United States | | Tagged as pups by the U.S.S.R. and tagged again as yearlings by the United States |
|---|---|---|
| Pup tag retained | Pup tag lost, marked as indicated 1/ | |
| | Yearling tag number (1T-series) 2/ | |
| | RH2 | |
| 3/ 16 ( 4162) | 203 | |
| 28 ( 8153) | 543 | |
| 35 ( 6949) | 973 | |
| 46 ( 7050) | 1074 | |
| 216 ( 5362) | | |
| 402 (11719) | | |
| 439 ( 3784) | | |
| 698 ( 7258) | | |
| 737 ( 9610) | | |
| 760 ( 4226) | | |
| 809 ( 4966) | | |
| 829 ( 9660) | | |
| 882 ( 771) | | |
| 1001 ( 9740) | | |
| 1013 (10315) | | |
| 1103 ( 3273) | | |

| | LFS | RH3 | LH2 | |
|---|---|---|---|---|
| | 94 | 34 | 2T-205 | 4/ 610 (16868) |
| | | 54 | | 770 (13426) |
| | | 208 | | 783 (22637) |
| | | 219 | | 944 (28552) |
| | | 222 | | 1040 (28797) |
| | | 408 | | |
| | | 412 | | |
| | | 534 | | |
| | | 614 | | |
| | | 656 | | |
| | | 720 | | |
| | | 728 | | |
| | | 806 | | |
| | | 838 | | |
| | | 856 | | |
| | | 864 | | |
| | | 877 | | |
| | | 894 | | |
| | | 1032 | | |
| | | 1036 | | |
| | | 1084 | | |

1/ RH2=right hind flipper, tip of number 2 digit sliced off; LFS= left front flipper, tip sliced off; RH3=right hind flipper, tip of number 3 digit sliced off; and LH2=left hind flipper, tip of number 2 digit sliced off.

2/ The single exception was tag no. 205, which was in the 2T-series.

3/ S-series pup tags.

4/ Y-series pup tags.

Table A-23.--Record of 1,220 male seals tagged at age ≥ 2 years, St. Paul Island, 28 September to 10 October 1967

| Rookery or hauling ground | Tag numbers (2T-series) | Effective tags |
|---|---|---|
| | | Number |
| Northeast Point | 1 | 1 |
| | 149-265 | 116 |
| | 609-732 | 124 |
| | 1101-1165 | 65 |
| English Bay Sands | 1/ 2-148 | 146 |
| | 266, 267 | 2 |
| | 328-608 | 279 |
| | 733-1100 | 364 |
| Polovina | 268-327 | 60 |
| | 1166-1228 | 63 |
| Total | | 1,220 |

1/ Tags 95 and 96 were attached to the same seal and the matching tags were discarded.

Table A-24.--Record of tag identification numbers for 144 male seals tagged or marked as pups and tagged again at age ≥ 2 years, St. Paul Island, 28 September to 10 October 1967

[Numbers in parentheses indicate pup tags.]

| Tagged or marked as pups by the United States and tagged again at ≥ 2 years by the United States | | | Tagged as pups by the U.S.S.R. and tagged again at ≥ 2 years by the United States |
|---|---|---|---|
| Pup tag retained 1/ | Marked as indicated 2/ | Double tag loss | |

Age ≥ 2 years tag number (2T-series)

| | RH1 | LFV | RFV | | |
|---|---|---|---|---|---|
| 167 (7095) | 10 | 4 | 85 | 526 | 5/ 506 (19559) |
| 170 (7038) | 41 | 71 | 165 | 560 | 855 (22757) |
| 171 (5298) | 73 | 130 | 215 | 633 | 1219 (19571) |
| 185 ( 33) | 97 | 191 | 286 | | |
| 190 (9595) | 114 | 280 | 289 | | |
| 192 (8111) | 126 | 366 | 335 | | |
| 210 (5079) | 128 | 429 | 343 | | |
| 236 (7067) | 144 | 773 | 390 | | |
| 256 (3735) | 189 | 796 | 423 | | |
| 266 (8814) | 225 | 946 | 440 | | |
| 293 (9643) | 227 | 1000 | 484 | | |
| 326 (5156) | 333 | 1022 | 563 | | |
| 339 (6843) | 349 | 1075 | 589 | | |
| 352 (7205) | 373 | 1076 | 703 | | |
| 380 (1264) | 420 | 1098 | 733 | | |
| 417 (5517) | 451 | 1190 | 735 | | |
| 455 (1707) | 453 | 1220 | 750 | | |
| 458 (8577) | 469 | | 4/ 762-TL | | |
| 460 (2153) | 480 | | 785 | | |
| 488 (9710) | 485 | | 818 | | |
| 503 (1581) | 490 | | 944 | | |
| 606 (2736) | 543 | | 982 | | |
| 607 (1841) | 566 | | 992 | | |
| 608 (9348) | 575 | | 1047 | | |
| 714 (6310) | 583 | | 1180 | | |
| 725 (4629) | 590 | | 1183 | | |
| 754 ( 161) | 639 | | | | |
| 760 (7995) | 663 | | | | |
| 787 ( 939) | 675 | | | | |
| 801 (9903) | 683 | | | | |

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See footnotes at end of table.

Table A-24.--Record of tag identification numbers for 144 male seals tagged or marked as pups and tagged again at age ≥ 2 years, St. Paul Island, 28 September to 10 October 1967--Continued

[Numbers in parentheses indicate pup tags.]

| Tagged or marked as pups by the United States and tagged again at ≥ 2 years by the United States | | | Tagged as pups by the U.S.S.R. and tagged again at ≥ 2 years by the United States |
|---|---|---|---|
| Pup tag retained 1/ | Marked as indicated 2/ | Double tag loss | |
| | Age ≥ 2 years tag number (2T-series) | | |
| | RH1 | LFV RFV | |
| 929 (8294) | 687 | | |
| 965 (3529) | 708 | | |
| 970 (1910) | 711 | | |
| 977 (6509) | 755 | | |
| 987 (3063) | 761 | | |
| 1027 (7367) | 781 | | |
| 1042 (1247) | 3/ 792-DTL | | |
| 1053 (4436) | 821 | | |
| 1058 (7113) | 983 | | |
| 1079 (7913) | 1044 | | |
| 1082 (7346) | 1051 | | |
| 1101 ( 289) | 1149 | | |
| 1107 (1521) | 1164 | | |
| 1137 (8047) | 1168 | | |
| 1138 (6847) | 1181 | | |
| 1172 (5195) | 1187 | | |
| 1216 (4423) | 1197 | | |
| | 1213 | | |

1/ R-series pup tags, except 3063 which was a rivet-type tag.

2/ RH1=right hind flipper, tip of number 1 digit sliced off; LFV=left front flipper, V-notch cut into leading edge near tip; RFV=right front flipper, V-notch cut into leading edge near tip.

3/ Double tags lost - tagged at age 1 or older.

4/ Single tag lost - tagged as a pup.

5/ T-series pup tags.

Table A-25.--Soviet tags recovered in the United States kill of fur seals, Pribilof Islands, Alaska, 26 June to 17 August 1967

| Island and date | Tag number | Age | Sex | Island of tagging | Rookery of recovery 1/ |
|---|---|---|---|---|---|
| | | Years | | | |
| St. Paul Island | | | | | |
| 19 July | T-16701 | 2 | M | Medny | ZAP |
| 5 August | T-17889 | 2 | M | " | L-K |
| 19 July | T-20138 | 2 | M | " | ZAP |
| 19 " | T-20438 | 2 | M | " | ZAP |
| 26 " | T-21618 | 2 | M | " | NEP |
| 29 " | T-21718 | 2 | M | " | TZR |
| 6 July | P-19477 | 3 | M | Bering | POL |
| 10 " | P-22502 | 3 | M | " | ZAP |
| 10 " | P-22595 | 3 | M | " | ZAP |
| 12 " | P-22951 & 22983 | 3 | M | " | NEP |
| 21 " | P-24133 | 3 | M | Medny | NEP |
| 4 August | P-24585 | 3 | M | " | NEP |
| 28 July | P-25001 | 3 | M | " | ZAP |
| 17 " | P-25889 | 3 | M | " | NEP |
| 7 " | P-26536 | 3 | M | " | NEP |
| 4 August | P-27136 | 3 | M | " | NEP |
| 31 July | P-27940 | 3 | M | " | NEP |
| 15 " | P-27947 | 3 | M | " | TZR |
| 26 " | P-28293 | 3 | M | " | NEP |
| 20 " | P-31060 & 31091 | 3 | M | " | TZR |
| 15 " | P-31990 | 3 | M | " | TZR |
| 15 " | P-31999 | 3 | M | " | TZR |
| 17 July | H- 9923 | 4 | M | Robben | NEP |
| 25 " | H-15071 | 4 | M | Bering | POL |
| 25 " | H-15085 | 4 | M | " | POL |
| 26 " | H-16950 | 4 | M | " | NEP |
| 26 " | H-16963 | 4 | M | " | NEP |
| 11 August | H-18146 | 4 | M | " | TZR |
| 8 July | H-22937 | 4 | M | Medny | REEF |
| 12 " | H-24346 | 4 | M | " | NEP |
| 27 " | H-26784 | 4 | M | " | REEF |
| 28 " | H-29004 | 4 | M | " | ZAP |
| 27 June | H-29158 | 4 | M | " | TZR |
| 14 July | H-29974 | 4 | M | " | ZAP |
| 14 July | M-14506 | 5 | M | Medny | ZAP |
| 19 " | M-16720 | 5 | M | " | ZAP |
| 5 August | M-19867 | 5 | M | " | ZAP |
| 29 July | K-15528 | 5 | M | Bering | POL |
| 14 August | P-23063 | 3 | F | Bering | POL |
| 14 " | K-18150 | 5 | F | " | NEP |
| 11 " | M-16596 | 5 | F | Medny | TZR |
| St. George Island | | | | | |
| 19 July | P-24878 | 3 | M | Medny | EAST |
| 24 " | P-24915 | 3 | M | " | EAST |
| 17 " | P-27490 | 3 | M | " | NORTH |
| 28 " | P-29193 & 29109 | 3 | M | " | NORTH |
| 26 " | P-30650 & 30677 | 3 | M | " | NORTH |
| 4 August | H-15067 &15091 | 4 | M | Bering | NORTH |
| 2 " | H-18969 | 4 | M | " | NORTH |
| 4 " | H-28258 & 28286 | 4 | M | Medny | EAST |
| 12 July | H-29660 | 4 | M | " | NORTH |
| 9 August | E-18847 | 6 | F | Medny | ZAP |
| 15 " | E-21377 | 6 | F | " | NORTH |
| 2 " | C-44680 | 7 | F | " | NORTH |

1/ ZAP=Zapadni; L-K=Lukanin-Kotovi; NEP=Northeast Point (Vostochni and Morjovi); TZR=Tolstoi-Zapadni Reef; POL=Polovina-Polovina Cliffs-Little Polovina; REEF=Reef-Gorbatch-Ardiguen; EAST=East Reef-East Cliffs; ZAP of St. George Island=Zapadni-South.

Table A-26.--Recovery location of tagged male seals killed, by age and rookery, Pribilof Islands, Alaska, 26 June to 5 August 1967

| Tag series, age, and rookery of tagging 1/ | Rookery of recovery 1/ | | | | | | | | | | | | Grand total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | St. Paul Island | | | | | | | St. George Island 2/ | | | | | |
| | ZAP-1 | TOL | L-K | REEF | POL | NEP | Total | ZAP-2 | NOR | EAST | STAR | Total | |
| | Number | | | | | | | Number | | | | | |
| R-series - age 2 | | | | | | | | | | | | | |
| ZAP-1 | 5 | - | - | - | - | 2 | 7 | - | - | - | - | - | 7 |
| TOL | 3 | 1 | - | 1 | - | 1 | 6 | - | - | - | - | - | 6 |
| L-K | - | - | 2 | - | - | 2 | 4 | - | - | - | - | - | 4 |
| REEF | 4 | - | - | 3 | - | - | 7 | - | - | - | - | - | 7 |
| POL | - | 1 | - | - | 4 | - | 5 | - | 1 | - | 1 | 2 | 7 |
| NEP | - | - | 1 | - | 2 | 5 | 8 | - | - | 1 | - | 1 | 9 |
| Front flipper mark 3/ | 26 | 8 | 5 | 13 | 8 | 24 | 84 | 9 | 2 | - | 2 | 13 | 97 |
| Hind flipper mark 3/ | 15 | 6 | 4 | 3 | 6 | 25 | 59 | 14 | 1 | 1 | - | 16 | 75 |
| Tags lost | 14 | 3 | 8 | 10 | 6 | 15 | 56 | - | 3 | 2 | 2 | 7 | 63 |
| Total | 67 | 19 | 20 | 30 | 26 | 74 | 236 | 23 | 7 | 4 | 5 | 39 | 275 |
| Q-series - age 3 | | | | | | | | | | | | | |
| ZAP-1 | 164 | 23 | 9 | 10 | 10 | 25 | 241 | 3 | 11 | 2 | - | 16 | 257 |
| TOL | 39 | 54 | 2 | 8 | 3 | 11 | 117 | 5 | 2 | 2 | 2 | 11 | 128 |
| L-K | 12 | 9 | 41 | 11 | 12 | 13 | 98 | 2 | 6 | 3 | - | 11 | 109 |
| REEF | 58 | 24 | 17 | 131 | 17 | 41 | 288 | 3 | 13 | 6 | 2 | 24 | 312 |
| POL | 16 | 5 | 13 | 8 | 62 | 14 | 118 | 2 | 4 | 2 | - | 8 | 126 |
| NEP | 17 | 6 | 8 | 8 | 20 | 220 | 279 | 2 | 8 | 14 | - | 24 | 305 |
| NOR | 11 | 3 | 4 | 7 | 1 | 7 | 33 | 6 | 93 | 11 | 3 | 113 | 146 |
| EAST | 3 | 1 | 1 | 3 | 1 | 4 | 13 | - | 11 | 49 | 1 | 61 | 74 |
| STAR | 4 | 2 | 2 | 6 | - | 3 | 17 | 1 | 18 | 12 | 14 | 45 | 62 |
| ZAP-2 | 7 | 2 | 4 | 6 | 2 | 6 | 27 | 16 | 14 | 9 | - | 39 | 66 |
| Tags lost | 135 | 49 | 39 | 93 | 59 | 185 | 560 | 13 | 45 | 29 | 5 | 92 | 652 |
| Total | 466 | 178 | 140 | 291 | 187 | 529 | 1,791 | 53 | 225 | 139 | 27 | 444 | 2,235 |
| P-series - age 4 | | | | | | | | | | | | | |
| ZAP-1 | 53 | 14 | - | 7 | 2 | 4 | 80 | - | 3 | 2 | - | 5 | 85 |
| TOL | 9 | 15 | 2 | 1 | 3 | 2 | 32 | - | - | 1 | - | 1 | 33 |
| L-K | 3 | 2 | 18 | 3 | 6 | 8 | 40 | - | 2 | - | - | 2 | 42 |
| REEF | 23 | 14 | 5 | 43 | 8 | 6 | 99 | - | 2 | 4 | - | 6 | 105 |
| POL | 5 | 4 | 3 | 4 | 54 | 12 | 82 | - | - | 1 | - | 1 | 83 |
| NEP | 1 | 2 | 2 | 2 | 5 | 118 | 130 | - | 3 | 2 | 1 | 6 | 136 |
| NOR | 1 | 1 | 2 | 1 | - | 3 | 8 | 3 | 53 | 7 | 2 | 65 | 73 |
| EAST | 4 | - | 1 | - | - | 3 | 8 | 1 | 6 | 26 | - | 33 | 41 |
| STAR | 1 | - | - | 1 | 1 | 3 | 6 | - | 5 | 1 | 5 | 11 | 17 |
| ZAP-2 | 2 | 2 | - | 1 | 1 | 1 | 7 | 24 | 8 | 4 | 1 | 37 | 44 |
| Tags lost | 68 | 27 | 39 | 52 | 38 | 90 | 314 | 10 | 21 | 15 | 2 | 48 | 362 |
| Total | 170 | 81 | 72 | 115 | 118 | 250 | 806 | 38 | 103 | 63 | 11 | 215 | 1,021 |
| O-series - age 5 | | | | | | | | | | | | | |
| ZAP-1 | 20 | 2 | - | - | - | - | 22 | - | - | - | - | - | 22 |
| TOL | 1 | 1 | - | - | - | - | 2 | - | - | - | - | - | 2 |
| L-K | - | - | 2 | - | - | - | 2 | - | - | - | - | - | 2 |
| REEF | 4 | 2 | - | 16 | - | - | 22 | 1 | 1 | - | - | 2 | 24 |
| POL | 2 | 1 | 1 | - | 7 | 1 | 12 | - | - | 1 | - | 1 | 13 |
| NEP | - | 1 | - | - | - | 16 | 17 | - | 1 | - | - | 1 | 18 |
| NOR | - | - | - | - | - | 2 | 2 | - | 12 | 2 | - | 14 | 16 |
| EAST | - | - | - | - | - | - | - | - | - | 10 | - | 10 | 10 |
| STAR | - | - | - | - | - | - | - | - | 2 | 1 | 1 | 4 | 4 |
| ZAP-2 | - | - | - | - | 1 | - | 1 | 7 | - | - | - | 7 | 8 |
| Tags lost | 20 | 10 | 22 | 8 | 13 | 19 | 92 | 5 | 7 | 10 | - | 22 | 114 |
| Total | 47 | 17 | 25 | 24 | 21 | 38 | 172 | 13 | 23 | 24 | 1 | 61 | 233 |
| N-series - age 6 | | | | | | | | | | | | | |
| ZAP-1 | 2 | - | - | - | - | - | 2 | - | - | - | - | - | 2 |
| TOL | - | 1 | - | - | - | - | 1 | - | - | - | - | - | 1 |
| NEP | - | - | - | - | - | 2 | 2 | - | - | - | - | - | 2 |
| STAR | - | - | - | - | - | - | - | - | - | - | 1 | 1 | 1 |
| Tags lost | 9 | 8 | - | 8 | 2 | 5 | 32 | 2 | 3 | - | - | 5 | 37 |
| Total | 11 | 9 | - | 8 | 2 | 7 | 37 | 2 | 3 | - | 1 | 6 | 43 |
| M-series - age 7 | | | | | | | | | | | | | |
| TOL | - | 1 | - | - | - | - | 1 | - | - | - | - | - | 1 |

1/ ZAP-1=Zapadni of St. Paul Island; TOL=Tolstoi; L-K=Lukanin-Kitovi; REEF=Reef, Gorbatch, and Ardiguen; POL=Polovina, Polovina Cliffs, and Little Polovina; NEP=Northeast Point (Vostochni-Morjovi); NOR=North; EAST=East Cliffs and East Reef; STAR=Staraya Artil; ZAP-2=Zapadni of St. George Island.

2/ Pups were not tagged on St. George Island in 1965 (R-series tags).

3/ Seals marked but not tagged--V-notch right front flipper and tip of 1st digit right hind flipper sliced off.

Table A-27.--Recovery location of tagged female seals killed, by age and rookery, Pribilof Islands, Alaska, 26 June to 17 August 1967

| Tag series, age, and rookery of tagging[1] | Rookery of recovery[1] | | | | | | | | | | | | Grand total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | St. Paul Island | | | | | | | St. George Island[2] | | | | | |
| | ZAP-1 | TOL | L-K | REEF | POL | NEP | Total | ZAP-2 | NOR | EAST | STAR | Total | |
| | Number | | | | | | | Number | | | | | |
| R-series - age 2 | | | | | | | | | | | | | |
| ZAP-1 | 1 | - | - | - | - | - | 1 | - | - | - | - | - | 1 |
| L-K | 1 | - | - | - | - | - | 1 | - | - | - | - | - | 1 |
| POL | - | - | - | - | 2 | - | 2 | - | - | - | - | - | 2 |
| Front flipper mark[3] | - | - | 1 | - | 1 | - | 2 | - | - | - | - | - | 2 |
| Hind flipper mark[3] | - | - | - | - | 1 | - | 1 | - | - | - | - | - | 1 |
| Tags lost | - | - | - | - | - | 2 | 2 | - | - | - | - | - | 2 |
| Total | 2 | - | 1 | - | 4 | 2 | 9 | - | - | - | - | - | 9 |
| Q-series - age 3 | | | | | | | | | | | | | |
| ZAP-1 | 1 | 2 | - | - | - | - | 3 | - | - | - | - | - | 3 |
| TOL | 2 | - | - | - | - | - | 2 | - | - | - | - | - | 2 |
| REEF | - | 1 | - | 4 | 1 | - | 6 | - | - | - | - | - | 6 |
| POL | - | - | - | - | 1 | - | 1 | - | - | - | - | - | 1 |
| NEP | 1 | - | 1 | - | 1 | 2 | 5 | - | 1 | - | - | 1 | 6 |
| NOR | - | - | - | - | 1 | - | 1 | - | - | - | 1 | 1 | 2 |
| EAST | - | 1 | - | - | - | - | 1 | - | - | - | - | - | 1 |
| STAR | - | - | - | - | - | 1 | 1 | - | - | - | 10 | 10 | 11 |
| ZAP-2 | - | - | - | - | - | - | - | 1 | - | - | - | 1 | 1 |
| Tags lost | 3 | 3 | - | 5 | 10 | 4 | 25 | 5 | - | - | 3 | 8 | 33 |
| Total | 7 | 7 | 1 | 9 | 14 | 7 | 45 | 6 | 1 | - | 14 | 21 | 66 |
| P-series - age 4 | | | | | | | | | | | | | |
| ZAP-1 | 1 | 1 | - | 1 | - | - | 3 | - | - | - | - | - | 3 |
| TOL | - | 1 | - | - | - | - | 1 | - | - | - | - | - | 1 |
| REEF | - | - | 1 | 9 | 1 | - | 11 | - | - | - | - | - | 11 |
| POL | 1 | - | - | - | 12 | - | 13 | - | - | - | - | - | 13 |
| NEP | 1 | 1 | 1 | - | - | 5 | 8 | - | - | - | - | - | 8 |
| NOR | - | - | - | - | - | - | - | - | 2 | - | 2 | 4 | 4 |
| STAR | - | - | - | - | - | 1 | 1 | - | - | - | 9 | 9 | 10 |
| ZAP-2 | 1 | - | - | - | - | - | 1 | - | - | - | - | - | 1 |
| Tags lost | 4 | 6 | - | 5 | 8 | 4 | 27 | - | 1 | - | 1 | 2 | 29 |
| Total | 8 | 9 | 2 | 15 | 21 | 10 | 65 | - | 3 | - | 12 | 15 | 80 |
| O-series - age 5 | | | | | | | | | | | | | |
| ZAP-1 | 17 | 7 | - | - | 1 | - | 25 | - | - | - | - | - | 25 |
| TOL | - | 1 | - | - | - | - | 1 | - | - | - | - | - | 1 |
| L-K | 1 | - | - | - | - | - | 1 | - | - | - | - | - | 1 |
| REEF | - | - | - | 21 | 2 | - | 23 | - | 1 | - | 1 | 2 | 25 |
| POL | - | - | - | - | 20 | 3 | 23 | - | - | - | - | - | 23 |
| NEP | - | 1 | - | - | 1 | 11 | 13 | - | - | - | - | - | 13 |
| NOR | - | - | - | - | - | 1 | 1 | 1 | 2 | - | - | 3 | 4 |
| EAST | - | - | - | - | - | - | - | - | - | - | 1 | 1 | 1 |
| STAR | - | - | - | - | - | - | - | - | - | - | 13 | 13 | 13 |
| ZAP-2 | - | - | - | - | 1 | - | 1 | 10 | - | - | - | 10 | 11 |
| Tags lost | 7 | 7 | 2 | 5 | 13 | 15 | 49 | - | 1 | - | 2 | 3 | 52 |
| Total | 25 | 16 | 2 | 26 | 38 | 30 | 137 | 11 | 4 | - | 17 | 32 | 169 |
| N-series - age 6 | | | | | | | | | | | | | |
| ZAP-1 | 6 | 2 | 1 | - | - | - | 9 | - | - | - | - | - | 9 |
| TOL | 1 | 2 | - | - | - | - | 3 | - | - | - | - | - | 3 |
| REEF | 1 | 2 | - | 10 | - | - | 13 | - | 1 | - | - | 1 | 14 |
| POL | - | - | - | - | 18 | - | 18 | - | - | - | - | - | 18 |
| NEP | 1 | - | - | - | - | 14 | 15 | - | - | - | - | - | 15 |
| NOR | - | - | - | - | 1 | - | 1 | - | - | - | 1 | 1 | 2 |
| EAST | - | - | - | - | - | - | - | - | 1 | - | - | 1 | 1 |
| STAR | - | - | - | - | - | - | - | - | - | - | 6 | 6 | 6 |
| ZAP-2 | - | - | - | - | - | - | - | 2 | - | - | - | 2 | 2 |
| Tags lost | 1 | 2 | - | 5 | 10 | 5 | 23 | - | - | - | - | - | 23 |
| Total | 10 | 8 | 1 | 15 | 29 | 19 | 82 | 2 | 2 | - | 7 | 11 | 93 |
| M-series - age 7 | | | | | | | | | | | | | |
| ZAP-1 | 1 | 2 | - | 1 | - | - | 4 | - | - | - | - | - | 4 |
| REEF | - | - | - | 8 | - | - | 8 | - | - | - | - | - | 8 |
| POL | - | - | - | - | 3 | 1 | 4 | - | - | - | - | - | 4 |
| NEP | - | - | - | - | - | 5 | 5 | - | - | - | - | - | 5 |
| NOR | - | - | - | - | - | - | - | - | 2 | - | 1 | 3 | 3 |
| ZAP-2 | - | - | - | - | - | - | - | 1 | - | - | - | 1 | 1 |
| Total | 1 | 2 | - | 9 | 3 | 6 | 21 | 1 | 2 | - | 1 | 4 | 25 |

Table A-27.--Recovery location of tagged female seals killed, by age and rookery, Pribilof Islands, Alaska, 26 June to 17 August 1967--Continued

| Tag series, age, and rookery of tagging[1] | Rookery of recovery[1] | | | | | | | | | | | | Grand total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | St. Paul Island | | | | | | | St. George Island[2] | | | | | |
| | ZAP-1 | TOL | L-K | REEF | POL | NEP | Total | ZAP-2 | NOR | EAST | STAR | Total | |
| | Number | | | | | | | Number | | | | | |
| **L-series - age 8** | | | | | | | | | | | | | |
| ZAP-1 | 1 | - | - | - | - | - | 1 | - | - | - | - | - | 1 |
| REEF | 1 | 1 | - | 4 | - | - | 6 | - | - | - | - | - | 6 |
| POL | - | - | - | - | 1 | 1 | 2 | - | - | - | - | - | 2 |
| STAR | - | - | - | - | - | - | - | - | - | - | 1 | 1 | 1 |
| Total | 2 | 1 | - | 4 | 1 | 1 | 9 | - | - | - | 1 | 1 | 10 |
| **K-series - age 9** | | | | | | | | | | | | | |
| L-K | - | - | - | - | - | 2 | 2 | - | - | - | - | - | 2 |
| REEF | - | - | - | 2 | - | - | 2 | - | - | - | - | - | 2 |
| POL | 2 | - | - | - | 2 | 1 | 5 | - | - | - | - | - | 5 |
| NEP | - | - | - | - | - | 6 | 6 | - | - | - | - | - | 6 |
| EAST | - | - | - | - | - | - | - | - | - | 1 | - | 1 | 1 |
| Total | 2 | - | - | 2 | 2 | 9 | 15 | - | - | 1 | - | 1 | 16 |
| **J-series - age 10** | | | | | | | | | | | | | |
| TOL | 2 | 1 | - | - | - | - | 3 | - | - | - | - | - | 3 |
| REEF | - | - | - | 1 | - | - | 1 | - | - | - | - | - | 1 |
| POL | - | - | - | - | 1 | - | 1 | - | - | - | - | - | 1 |
| EAST | - | - | - | - | - | - | - | 1 | - | - | - | 1 | 1 |
| Total | 2 | 1 | - | 1 | 1 | - | 5 | 1 | - | - | - | 1 | 6 |
| **I-series - age 11** | | | | | | | | | | | | | |
| ZAP-1 | 2 | 1 | - | - | - | - | 3 | - | - | - | - | - | 3 |
| NEP | - | - | - | - | - | 1 | 1 | - | - | - | - | - | 1 |
| STAR | - | - | - | - | - | - | - | - | - | - | 1 | 1 | 1 |
| ZAP-2 | - | - | - | - | - | - | - | 1 | - | - | - | 1 | 1 |
| Total | 2 | 1 | - | - | - | 1 | 4 | 1 | - | - | 1 | 2 | 6 |
| **H-series - age 12** | | | | | | | | | | | | | |
| ZAP-1 | 1 | 1 | - | - | - | - | 2 | - | - | - | - | - | 2 |
| TOL | - | - | - | 1 | - | - | 1 | - | - | - | - | - | 1 |
| L-K | - | - | 1 | - | - | - | 1 | - | - | - | - | - | 1 |
| REEF | - | - | - | 1 | - | - | 1 | - | - | - | - | - | 1 |
| NEP | - | - | - | - | - | 1 | 1 | - | - | - | - | - | 1 |
| Total | 1 | 1 | 1 | 2 | - | 1 | 6 | - | - | - | - | - | 6 |
| **G-series - age 13** | | | | | | | | | | | | | |
| ZAP-1 | 1 | - | - | - | - | - | 1 | - | - | - | - | - | 1 |
| REEF | - | - | - | 2 | - | - | 2 | - | - | - | - | - | 2 |
| NEP | - | - | - | - | - | 2 | 2 | - | - | - | - | - | 2 |
| Total | 1 | - | - | 2 | - | 2 | 5 | - | - | - | - | - | 5 |
| **E-series - age 15** | | | | | | | | | | | | | |
| REEF | 1 | - | - | - | - | - | 1 | - | - | - | - | - | 1 |
| NEP | - | - | - | - | - | 3 | 3 | - | - | - | - | - | 3 |
| Total | 1 | - | - | - | - | 3 | 4 | - | - | - | - | - | 4 |
| **CS-series - age 18** | | | | | | | | | | | | | |
| REEF | - | - | - | 1 | - | - | 1 | - | - | - | - | - | 1 |
| NEP | - | - | - | - | - | 2 | 2 | - | - | - | - | - | 2 |
| Total | - | - | - | 1 | - | 2 | 3 | - | - | - | - | - | 3 |

1/ ZAP-1=Zapadni of St. Paul Island; TOL=Tolstoi; L-K=Lukanin-Kitovi; REEF=Reef, Gorbatch, and Ardiguen; POL=Polovina, Polovina Cliffs, and Little Polovina; NEP=Northeast Point (Vostochni-Morjovi); NOR=North; EAST=East Cliffs and East Reef; STAR=Staraya Artil; ZAP-2=Zapadni of St. George Island.

2/ Pups were not tagged on St. George Island in 1965 (R-series tags).

3/ Seals marked but not tagged--V-notch right front flipper and tip of 1st digit right hind flipper sliced off.

# APPENDIX B

## PERSONS ENGAGED IN FUR SEAL RESEARCH IN 1967

### Pribilof Islands

| Name | Arrival | Departure | Affiliation | Work |
|---|---|---|---|---|
| Patrick Kozloff | 24 May | 5 Sept. | Student, U. of Alaska | Seal research, general |
| Lavrenty Stepetin | 24 May | 10 Oct. | St. Paul Island resident | Do. |
| Raymond Anas | 14 June | 17 Aug. | Bureau of Commercial Fisheries | Do. |
| Daniel Odell | 14 June | 5 Sept. | Graduate, Cornell U. | Do. |
| Alton Roppel | 21 June | 10 Aug. | Bureau of Commercial Fisheries | Do. |
| Gilbert Moore | 21 June | 17 Aug. | Science teacher, Redmond Junior High School | Do. |
| Dionsey Bourdukofsky | 27 June | 5 Sept. | St. Paul Island resident | Do. |
| Mark Keyes | 28 June | 17 Aug. | Bureau of Commercial Fisheries | Seal research, mortality |
| Donald Bosman | 28 June | 17 Aug. | Student, Wash. State U. | Do. |
| Agafon Krukoff, Jr. | 5 July | 5 Sept. | St. Paul Island resident | Seal research, general |
| Ronald Pletnikoff | 5 July | 24 Aug. | --------do.---------- | Do. |
| David Galaktionoff | 20 July | 31 Aug. | --------do.---------- | Do. |
| Ford Wilke | 26 July | 24 Aug. | Bureau of Commercial Fisheries | Do. |
| Ancel Johnson | 20 Sept. | 11 Oct. | --------do.---------- | Do. |
| Clifford Fiscus | 20 Sept. | 11 Oct. | --------do.---------- | Do. |

### Pelagic Investigations

| Name | Vessel | Area or place of work | Period |
|---|---|---|---|
| C. H. Fiscus | M/V Pribilof | Bering Sea | 11 Nov. to 8 Dec. 1966 |
| --------do.--------- | --------do.--------- | Washington | 6 Jan. to 13 Feb. 1967 |
| H. Kajimura | M/V Tenyu Maru | Off northern Honshu Island, Japan | 10 Apr. to 22 May 1967 |
| H. Kajimura | M/V John N. Cobb | Washington-Oregon | 21 Aug. to 8 Sept. 1967 |
| R. K. Stroud | M/V Tonquin | Washington | 5 Jan. to 17 Feb. 1967 |
| --------do.--------- | M/V Yaquina | Oregon | 25-29 Aug. 1967 |
| --------do.--------- | --------dO.--------- | Oregon-California | 16-22 Sept. 1967 |
| P. Iwanaga (temporary employee) | M/V Tonquin Marine Mammal | Washington Biological Laboratory | 5 Jan. to 17 Feb. 3-4 Jan. and 18 Feb- 19 May 1967 |

# APPENDIX C

Table C-1.--Observations of seals in the eastern Aleutian Islands from M/V Pribilof, November to December 1966

| Date | Hours of observation | Locality | Seals seen, collected, wounded, or killed |
|---|---|---|---|
| | Number | | Number |
| 22 Nov. | 7 | Off Unalaska, Cape Cheerful to Akutan Island | 5 |
| 23 Nov. | 7 | Unalaska to Akun Bay, Akun Island, north of Akutan Island | 8 (1 collected) |
| 25 Nov. | 6+ | West side of Unimak Pass | 2 |
| 26 Nov. | 4 | West side of Unimak Pass, Avatanik Strait | 0 |
| 28 Nov. | 8 | West side of Unimak Pass, north side of Akun Island | 8 (1 killed, lost) |
| 29 Nov. | 8 | North side of Akun Island, northwest side of Unimak Pass | 7 (1 wounded, lost) |
| 30 Nov. | 6 | North side of Akutan and Akun Islands | 5 |
| 1 Dec. | 7 | Akutan Bay, north side of Akutan Island to Unalaska | 2 |

Table C-2.--List of chart squares occupied by research vessels off Washington in January 1967, showing hours in square, seals seen per hour, and number of seals seen and collected[1]

| Square | Hours per square | Seals seen per hour | Seals | |
|---|---|---|---|---|
| | | | Seen | Collected |
| Number | Number | Number | Number | Number |
| V25-H9 | 1.0 | 0.0 | 0 | 0 |
| V25-H10 | 1.0 | 1.0 | 1 | 0 |
| V25-H11 | 0.9 | 2.2 | 2 | 0 |
| V25-H12 | 1.0 | 0.0 | 0 | 0 |
| V25-H13 | 0.1 | 0.0 | 0 | 0 |
| V25-H21 | 0.7 | 0.0 | 0 | 0 |
| V25-H22 | 0.8 | 0.0 | 0 | 0 |
| V25-H23 | 1.0 | 0.0 | 0 | 0 |
| V25-H24 | 0.9 | 1.1 | 1 | 0 |
| V25-H25 | 1.0 | 0.0 | 0 | 0 |
| V25-H26 | 1.0 | 1.0 | 1 | 0 |
| V25-H27 | 0.9 | 0.0 | 0 | 0 |
| V25-H28 | 0.9 | 0.0 | 0 | 0 |
| V25-H29 | 0.8 | 0.0 | 0 | 0 |
| V25-H30 | 0.9 | 1.1 | 1 | 0 |
| V25-H31 | 0.2 | 0.0 | 0 | 0 |
| V25-H42 | 0.3 | 0.0 | 0 | 0 |
| V25-H43 | 1.0 | 0.0 | 0 | 0 |
| V25-H44 | 1.0 | 0.0 | 0 | 0 |
| V25-H45 | 1.0 | 0.0 | 0 | 0 |
| V25-H46 | 1.0 | 0.0 | 0 | 0 |
| V25-H47 | 1.0 | 0.0 | 0 | 0 |
| V25-H48 | 1.0 | 0.0 | 0 | 0 |
| V25-H49 | 0.6 | 1.7 | 1 | 0 |
| V25-H50 | 1.1 | 0.0 | 0 | 0 |
| V25-H51 | 0.8 | 0.0 | 0 | 0 |
| V26-H9 | 0.8 | 0.0 | 0 | 0 |
| V26-H10 | 2.8 | 0.0 | 0 | 0 |
| V26-H11 | 4.6 | 2.4 | 11 | 3 |
| V26-H12 | 1.2 | 0.8 | 1 | 0 |
| V26-H13 | 1.2 | 2.5 | 3 | 0 |
| V27-H11 | 2.0 | 2.5 | 5 | 2 |

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[1] See footnote at end of table.

Table C-2.--List of chart squares occupied by research vessels off Washington in January 1967, showing hours in square, seals seen per hour, and number of seals seen and collected[1]--Continued

| Square | Hours per square | Seals seen per hour | Seals | |
|---|---|---|---|---|
| | | | Seen | Collected |
| Number | Number | Number | Number | Number |
| V28-H11 | 1.0 | 0.0 | 0 | 0 |
| V28-H12 | 2.0 | 0.5 | 1 | 0 |
| V28-H13 | 1.0 | 0.0 | 0 | 0 |
| V28-H14 | 1.3 | 1.5 | 2 | 0 |
| V28-H15 | 1.6 | 2.5 | 4 | 1 |
| V28-H16 | 1.0 | 0.0 | 0 | 0 |
| V28-H17 | 1.0 | 0.0 | 0 | 0 |
| V28-H18 | 0.8 | 1.2 | 1 | 0 |
| V28-H19 | 0.9 | 0.0 | 0 | 0 |
| V28-H20 | 0.4 | 0.0 | 0 | 0 |
| V29-H11 | 0.8 | 0.0 | 0 | 0 |
| V29-H12 | 0.5 | 16.0 | 8 | 0 |
| V29-H13 | 1.0 | 0.0 | 0 | 0 |
| V29-H14 | 1.0 | 0.0 | 0 | 0 |
| V29-H15 | 1.1 | 3.6 | 4 | 0 |
| V29-H16 | 1.4 | 0.7 | 1 | 0 |
| V29-H17 | 1.0 | 2.0 | 2 | 0 |
| V29-H18 | 1.1 | 0.9 | 1 | 0 |
| V29-H19 | 0.9 | 0.0 | 0 | 0 |
| V29-H20 | 0.8 | 1.2 | 1 | 0 |
| V29-H21 | 0.7 | 0.0 | 0 | 0 |
| V29-H36 | 0.5 | 0.0 | 0 | 0 |
| V29-H37 | 0.7 | 0.0 | 0 | 0 |
| V29-H38 | 1.3 | 0.0 | 0 | 0 |
| V29-H39 | 1.0 | 0.0 | 0 | 0 |
| V29-H40 | 1.2 | 0.0 | 0 | 0 |
| V29-H41 | 1.0 | 0.0 | 0 | 0 |
| V29-H42 | 0.8 | 0.0 | 0 | 0 |
| V29-H43 | 1.5 | 0.0 | 0 | 0 |
| V29-H44 | 1.0 | 0.0 | 0 | 0 |
| V29-H45 | 0.2 | 0.0 | 0 | 0 |
| V30-H10 | 2.0 | 4.5 | 9 | 4 |
| V30-H11 | 7.5 | 4.3 | 32 | 12 |
| V37-H12 | 2.0 | 0.5 | 1 | 0 |
| V37-H13 | 2.4 | 3.3 | 8 | 0 |

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[1] See footnote at end of table.

Table C-2.--List of chart squares occupied by research vessels off Washington in January 1967, showing hours in square, seals seen per hour, and number of seals seen and collected[1]--Continued

| Square | Hours per square | Seals seen per hour | Seals | |
|---|---|---|---|---|
| | | | Seen | Collected |
| Number | Number | Number | Number | Number |
| V37-H14 | 4.4 | 4.3 | 19 | 6 |
| V37-H15 | 1.1 | 0.0 | 0 | 0 |
| V37-H16 | 2.5 | 0.4 | 1 | 0 |
| V37-H17 | 2.8 | 1.1 | 3 | 0 |
| V37-H18 | 1.7 | 0.6 | 1 | 0 |
| V37-H19 | 1.0 | 0.0 | 0 | 0 |
| V37-H20 | 0.3 | 0.0 | 0 | 0 |
| V37-H25 | 0.3 | 0.0 | 0 | 0 |
| V37-H26 | 1.0 | 0.0 | 0 | 0 |
| V37-H27 | 0.9 | 0.0 | 0 | 0 |
| V37-H28 | 1.1 | 0.0 | 0 | 0 |
| V37-H29 | 0.9 | 2.2 | 2 | 0 |
| V37-H30 | 1.0 | 0.0 | 0 | 0 |
| V37-H31 | 0.9 | 0.0 | 0 | 0 |
| V37-H32 | 0.8 | 2.5 | 2 | 0 |
| V37-H33 | 1.2 | 0.0 | 0 | 0 |
| V37-H34 | 1.0 | 0.0 | 0 | 0 |
| V37-H35 | 0.1 | 0.0 | 0 | 0 |
| V37-H41 | 0.3 | 0.0 | 0 | 0 |
| V37-H42 | 1.1 | 0.0 | 0 | 0 |
| V37-H43 | 1.1 | 0.0 | 0 | 0 |
| V37-H44 | 1.0 | 0.0 | 0 | 0 |
| V37-H45 | 0.9 | 0.0 | 0 | 0 |
| V37-H46 | 0.8 | 1.2 | 1 | 0 |
| V37-H47 | 1.1 | 0.9 | 1 | 0 |
| V37-H48 | 0.9 | 0.0 | 0 | 0 |
| V37-H49 | 0.9 | 0.0 | 0 | 0 |
| V37-H50 | 0.9 | 0.0 | 0 | 0 |
| V38-H12 | 3.9 | 0.0 | 0 | 0 |
| V38-H13 | 4.6 | 3.9 | 18 | 5 |
| V38-H14 | 7.6 | 6.3 | 48 | 2 |

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[1] See footnote at end of table.

Table C-2.--List of chart squares occupied by research vessels off Washington in January 1967, showing hours in square, seals seen per hour, and number of seals seen and collected[1]--Continued

| Square | Hours per square | Seals seen per hour | Seals | |
|---|---|---|---|---|
| | | | Seen | Collected |
| Number | Number | Number | Number | Number |
| V38-H15 | 1.8 | 4.4 | 8 | 0 |
| V38-H16 | 1.2 | 2.5 | 3 | 0 |
| V38-H18 | 1.2 | 1.7 | 2 | 0 |
| V38-H19 | 0.2 | 5.0 | 1 | 0 |
| V39-H11 | 3.9 | 0.0 | 0 | 0 |
| V39-H12 | 19.9 | 1.8 | 37 | 3 |
| V39-H13 | 15.0 | 4.8 | 72 | 17 |
| V39-H14 | 3.0 | 1.0 | 3 | 0 |
| V39-H15 | 1.5 | 4.7 | 7 | 1 |
| V39-H16 | 1.6 | 0.6 | 1 | 0 |
| V40-H12 | 2.8 | 2.8 | 8 | 2 |
| V40-H13 | 9.0 | 2.2 | 20 | 7 |
| V40-H14 | 4.3 | 0.9 | 4 | 1 |
| V40-H15 | 5.9 | 2.0 | 12 | 1 |
| V40-H16 | 8.0 | 6.5 | 52 | 7 |
| V40-H17 | 4.7 | 1.7 | 8 | 1 |
| V40-H18 | 1.0 | 1.0 | 1 | 0 |
| V40-H19 | 1.0 | 0.0 | 0 | 0 |
| V40-H20 | 1.0 | 0.0 | 0 | 0 |
| V40-H21 | 1.0 | 0.0 | 0 | 0 |
| V40-H22 | 1.4 | 0.0 | 0 | 0 |
| V40-H23 | 1.2 | 0.8 | 1 | 0 |
| V40-H24 | 1.1 | 0.0 | 0 | 0 |
| V41-H15 | 0.8 | 2.5 | 2 | 0 |
| V41-H16 | 1.6 | 0.0 | 0 | 0 |
| V41-H17 | 3.0 | 0.0 | 0 | 0 |
| V41-H18 | 0.9 | 0.0 | 0 | 0 |
| V42-H18 | 1.1 | 0.0 | 0 | 0 |
| V43-H19 | 1.0 | 1.0 | 1 | 0 |
| V43-H20 | 0.9 | 3.3 | 3 | 0 |
| V43-H21 | 0.7 | 2.8 | 2 | 0 |

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[1] See footnote at end of table.

Table C-2.--List of chart squares occupied by research vessels off Washington in January 1967, showing hours in square, seals seen per hour, and number of seals seen and collected[1]--Continued

| Square | Hours per square | Seals seen per hour | Seals | |
|---|---|---|---|---|
| | | | Seen | Collected |
| Number | Number | Number | Number | Number |
| V43-H22 | 0.7 | 0.0 | 0 | 0 |
| V43-H23 | 0.8 | 0.0 | 0 | 0 |
| V43-H24 | 1.0 | 2.0 | 2 | 0 |
| V43-H25 | 1.0 | 1.0 | 1 | 0 |
| V43-H26 | 0.9 | 2.2 | 2 | 0 |
| V43-H27 | 1.0 | 1.0 | 1 | 0 |
| V43-H28 | 1.0 | 0.0 | 0 | 0 |
| V43-H29 | 0.2 | 0.0 | 0 | 0 |
| V43-H39 | 1.0 | 0.0 | 0 | 0 |
| V43-H40 | 1.4 | 3.6 | 5 | 0 |
| V43-H41 | 0.6 | 5.0 | 3 | 0 |
| V43-H42 | 1.1 | 0.9 | 1 | 1 |
| V43-H43 | 2.0 | 1.5 | 3 | 0 |
| V43-H44 | 1.5 | 2.7 | 4 | 3 |
| V43-H45 | 1.9 | 4.2 | 8 | 1 |

1/ The base chart is U.S.C.G.S. no. 5002. A chart square forms an area of 343 square kilometers (100 square nautical miles). The side of each measures 18.52 kilometers (10 nautical miles). Squares are located by a system of vertical and horizontal numbers. Horizontal numbering begins at the lower right corner of each chart and vertical numbering at the lower left corner.

Table C-3.--List of chart squares occupied by research vessels off Washington in February 1967, showing hours in square, seals seen per hour, and number of seals seen and collected[1]

| Square | Hours per square | Seals seen per hour | Seals | |
|---|---|---|---|---|
| | | | Seen | Collected |
| Number | Number | Number | Number | Number |
| V30-H11 | 2.0 | 4.0 | 8 | 1 |
| V31-H11 | 2.7 | 10.0 | 27 | 6 |
| V31-H12 | 1.3 | 5.4 | 7 | 3 |
| V31-H16 | 1.1 | 0.9 | 1 | 0 |
| V31-H17 | 0.8 | 0.0 | 0 | 0 |
| V31-H18 | 1.4 | 1.4 | 2 | 0 |
| V31-H19 | 0.7 | 1.4 | 1 | 0 |
| V32-H11 | 0.8 | 7.5 | 6 | 2 |
| V32-H12 | 5.7 | 6.1 | 35 | 4 |
| V32-H13 | 1.0 | 2.0 | 2 | 0 |
| V32-H15 | 0.5 | 4.0 | 2 | 0 |
| V32-H16 | 0.5 | 0.0 | 0 | 0 |
| V33-H12 | 3.2 | 9.4 | 30 | 0 |
| V33-H13 | 1.6 | 0.6 | 1 | 0 |
| V33-H14 | 1.1 | 0.0 | 0 | 0 |
| V33-H15 | 0.6 | 0.0 | 0 | 0 |
| V34-H12 | 0.8 | 6.2 | 5 | 0 |
| V34-H13 | 2.1 | 4.3 | 9 | 0 |
| V34-H14 | 0.6 | 3.3 | 2 | 0 |
| V34-H16 | 0.2 | 0.0 | 0 | 0 |
| V34-H17 | 1.2 | 0.0 | 0 | 0 |
| V34-H18 | 0.8 | 1.2 | 1 | 0 |
| V34-H19 | 1.0 | 0.0 | 0 | 0 |
| V34-H20 | 0.8 | 0.0 | 0 | 0 |
| V34-H21 | 0.8 | 0.0 | 0 | 0 |
| V34-H22 | 1.0 | 1.0 | 1 | 0 |
| V34-H23 | 1.0 | 0.0 | 0 | 0 |
| V34-H24 | 1.2 | 0.0 | 0 | 0 |
| V34-H25 | 1.0 | 0.0 | 0 | 0 |
| V34-H26 | 0.3 | 0.0 | 0 | 0 |
| V34-H34 | 0.6 | 1.7 | 1 | 0 |

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[1] See footnote at end of table.

Table C-3.--List of chart squares occupied by research vessels off Washington in February 1967, showing hours in square, seals seen per hour, and number of seals seen and collected[1]--Continued

| Square | Hours per square | Seals seen per hour | Seals | |
|---|---|---|---|---|
| | | | Seen | Collected |
| Number | Number | Number | Number | Number |
| V34-H35 | 1.0 | 1.0 | 1 | 0 |
| V34-H36 | 0.9 | 1.1 | 1 | 0 |
| V34-H37 | 1.0 | 0.0 | 0 | 0 |
| V34-H38 | 0.9 | 2.2 | 2 | 0 |
| V34-H39 | 1.0 | 0.0 | 0 | 0 |
| V34-H40 | 1.0 | 2.0 | 2 | 0 |
| V34-H41 | 0.8 | 1.2 | 1 | 0 |
| V34-H42 | 1.0 | 0.0 | 0 | 0 |
| V34-H43 | 1.3 | 0.0 | 0 | 0 |
| V35-H12 | 1.7 | 1.8 | 3 | 0 |
| V35-H13 | 3.4 | 12.0 | 41 | 2 |
| V35-H14 | 1.8 | 0.6 | 1 | 0 |
| V36-H13 | 2.2 | 4.1 | 9 | 3 |
| V36-H14 | 1.3 | 2.3 | 3 | 0 |
| V37-H12 | 0.5 | 0.0 | 0 | 0 |
| V37-H13 | 4.1 | 3.9 | 16 | 1 |
| V37-H14 | 1.1 | 0.0 | 0 | 0 |
| V38-H12 | 2.9 | 0.3 | 1 | 0 |
| V38-H13 | 5.8 | 2.2 | 13 | 0 |
| V38-H14 | 1.0 | 1.0 | 1 | 0 |
| V38-H15 | 0.2 | 0.0 | 0 | 0 |
| V38-H16 | 2.3 | 0.4 | 1 | 0 |
| V38-H17 | 1.5 | 0.7 | 1 | 0 |
| V39-H11 | 3.4 | 0.0 | 0 | 0 |
| V39-H12 | 6.9 | 0.0 | 0 | 0 |
| V39-H13 | 4.8 | 0.8 | 4 | 1 |
| V39-H14 | 5.7 | 1.4 | 8 | 3 |
| V39-H15 | 9.6 | 6.1 | 59 | 9 |
| V39-H16 | 9.6 | 5.2 | 50 | 14 |
| V39-H17 | 1.6 | 0.6 | 1 | 0 |

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[1] See footnote at end of table.

Table C-3.--List of chart squares occupied by research vessels off Washington in February 1967, showing hours in square, seals seen per hour, and number of seals seen and collected[1]--Continued

| Square | Hours per square | Seals seen per hour | Seals | |
|---|---|---|---|---|
| | | | Seen | Collected |
| Number | Number | Number | Number | Number |
| V39-H18 | 1.3 | 0.8 | 1 | 0 |
| V39-H19 | 0.2 | 5.0 | 1 | 0 |
| V40-H13 | 1.2 | 0.0 | 0 | 0 |
| V40-H15 | 0.2 | 10.0 | 2 | 1 |
| V40-H16 | 1.1 | 1.8 | 2 | 1 |
| V40-H27 | 1.8 | 0.0 | 0 | 0 |
| V40-H28 | 1.5 | 0.0 | 0 | 0 |
| V40-H29 | 1.5 | 0.0 | 0 | 0 |
| V40-H30 | 1.2 | 0.0 | 0 | 0 |
| V40-H31 | 1.3 | 0.0 | 0 | 0 |
| V40-H32 | 1.3 | 2.3 | 3 | 0 |
| V40-H33 | 1.1 | 0.0 | 0 | 0 |

1/ The base chart is U.S.C.G.S. no. 5002. A chart square forms an area of 343 square kilometers (100 square nautical miles). The side of each measures 18.52 kilometers (10 nautical miles). Squares are located by a system of vertical and horizontal numbers. Horizontal numbering begins at the lower right corner of each chart and vertical numbering at the lower left corner.

Table C-4.--Number of seals seen, and number seen per boat-hunting day, by 10-day periods, off Washington, 6 January to 12 February 1967

| Period | Boat-hunting days[1/] | Total seals seen | Seals seen per boat-hunting day | Seals seen per 10-day interval |
|---|---|---|---|---|
| | Number | Number | Number | Percent |
| 1-10 Jan. | 6.00 | 102 | 17.0 | 12.2 |
| 11-20 " | 12.25 | 219 | 17.9 | 26.2 |
| 21-31 " | 8.75 | 155 | 17.7 | 18.6 |
| 1-10 Feb. | 11.50 | 291 | 25.3 | 34.9 |
| 11-20 " | 2.00 | 68 | 34.0 | 8.1 |
| Total | 40.50 | 835 | 20.6 | 100.0 |

[1/] A boat-hunting day is a day in which a vessel is used for 8 hours or more; units of boat-hunting days are 0.25, 0.50, 0.75, and 1.00.

Table C-5.--Number of seals collected, and number collected per boat-hunting day, by 10-day periods, off Washington, 6 January to 12 February 1967

| Period | Boat hunting days[1/] | Seals collected | | | Seals collected per boat-hunting day | |
|---|---|---|---|---|---|---|
| | | Males | Females | Total | | |
| | Number | Number | Number | Number | Number | Percent |
| 1-10 Jan. | 6.00 | 0 | 10 | 10 | 1.7 | 7.6 |
| 11-20 " | 12.25 | 4 | 37 | 41 | 3.4 | 31.3 |
| 21-31 " | 8.75 | 3 | 26 | 29 | 3.3 | 22.1 |
| 1-10 Feb. | 11.50 | 6 | 44 | 50 | 4.4 | 38.2 |
| 11-20 " | 2.00 | 0 | 1 | 1 | 0.5 | 0.8 |
| Total | 40.50 | 13 | 118 | 131 | 3.2 | 100.0 |

[1/] A boat-hunting day is a day in which a vessel is used for 8 hours or more; units of boat-hunting days are 0.25, 0.50, 0.75, and 1.00.

Table C-6.--Number of seals per group among 835 seals sighted off Washington, 6 January to 12 February 1967

| Number of seals in group | Groups | Seals | Seals |
|---|---|---|---|
| | Number | Number | Percent |
| 1 | 361 | 361 | 43.3 |
| 2 | 106 | 212 | 25.4 |
| 3 | 39 | 117 | 14.0 |
| 4 | 19 | 76 | 9.1 |
| 5 | 8 | 40 | 4.8 |
| 6 | 1 | 6 | 0.7 |
| 7 | 1 | 7 | 0.8 |
| 8 | 2 | 16 | 1.9 |
| Total | 537 | 835 | 100.0 |

Table C-7.--Total seals sighted, collected, wounded and lost, and killed and lost, 1958-67

| Year | Total seals sighted | Sighted seals | | | | | |
|---|---|---|---|---|---|---|---|
| | | Collected | | Wounded and lost | | Killed and lost[1] | |
| | Number | Number | Percent | Number | Percent | Number | Percent |
| 1958 | 7,024 | 1,503 | 21.4 | 302 | 4.3 | 255 | 3.6 |
| 1959 | 5,919 | 1,548 | 26.2 | 316 | 5.3 | 286 | 4.8 |
| 1960 | 6,287 | 1,495 | 23.8 | 271 | 4.3 | 241 | 3.8 |
| 1961 | 3,415 | 1,352 | 40.0 | 176 | 5.2 | 124 | 3.6 |
| 1962 | 6,111 | 1,483 | 24.3 | 178 | 2.9 | 133 | 2.2 |
| 1963 | 5,790 | 1,355 | 23.4 | 202 | 3.5 | 143 | 2.5 |
| 1964 | 2,864 | 883 | 30.8 | 97 | 3.4 | 68 | 2.4 |
| 1965 | 1,627 | 419 | 27.8 | 50 | 3.1 | 45 | 2.8 |
| 1966 | 2,704 | 444 | 16.4 | 78 | 2.9 | 67 | 2.5 |
| 1967[2] | 897 | 132 | 14.7 | 27 | 3.0 | 22 | 2.5 |
| Total | 42,638 | 10,614 | 24.9 | 1,697 | 4.0 | 1,384 | 3.2 |

1/ Killed seals that sank before they could be retrieved.

2/ Includes 16 days during November and December 1966.

Table C-8.--Number and percentage of seals shot at sea that were collected, wounded and lost, and killed and lost, 1958-67

| Year | Total seals shot | Seals shot | | | | | |
|---|---|---|---|---|---|---|---|
| | | Collected | | Wounded and lost | | Killed and lost 1/ | |
| | Number | Number | Percent | Number | Percent | Number | Percent |
| 1958 | 2,060 | 1,503 | 73.0 | 302 | 14.6 | 255 | 12.4 |
| 1959 | 2,150 | 1,548 | 72.0 | 316 | 14.7 | 286 | 13.3 |
| 1960 | 2,007 | 1,495 | 74.5 | 271 | 13.5 | 241 | 12.0 |
| 1961 | 1,652 | 1,352 | 81.8 | 176 | 10.7 | 124 | 7.5 |
| 1962 | 1,794 | 1,483 | 82.7 | 178 | 9.9 | 133 | 7.4 |
| 1963 | 1,700 | 1,355 | 79.7 | 202 | 11.9 | 143 | 8.4 |
| 1964 | 1,048 | 883 | 84.3 | 97 | 9.3 | 68 | 6.4 |
| 1965 | 514 | 419 | 81.5 | 50 | 9.7 | 45 | 8.8 |
| 1966 | 589 | 444 | 75.4 | 78 | 13.2 | 67 | 11.4 |
| 1967 2/ | 181 | 132 | 72.9 | 27 | 14.9 | 22 | 12.2 |
| Total | 13,695 | 10,614 | 77.5 | 1,697 | 12.4 | 1,384 | 10.1 |

1/ Killed seals that sank before they could be retrieved.

2/ Includes 16 days during November and December 1966.

Table C-9.--Monthly mean lengths of pregnant fur seals collected pelagically by the United States off Washington in 1967

| Age | January | | February | | January-February | | |
|---|---|---|---|---|---|---|---|
| | Seals | Mean length | Seals | Mean length | Seals | Mean length | Standard deviation |
| Years | Number | Cm. | Number | Cm. | Number | Cm. | Cm. |
| 5 | 2 | 115.5 | 2 | 112.5 | 4 | 114.0 | |
| 6 | 8 | 120.5 | 4 | 120.7 | 12 | 120.6 | 3.0 |
| 7 | 1 | 125.0 | 4 | 123.7 | 5 | 124.0 | 7.8 |
| 8 | 3 | 121.3 | 3 | 128.7 | 6 | 125.0 | 5.9 |
| 9 | 10 | 122.9 | 2 | 130.0 | 12 | 124.1 | 7.2 |
| 10 | 5 | 126.2 | 5 | 129.2 | 10 | 127.7 | 4.0 |
| 11 | 3 | 124.3 | 1 | 132.0 | 4 | 126.2 | |
| 12 | 1 | 121.0 | 1 | 134.0 | 2 | 127.5 | |
| 13 | 2 | 125.0 | 1 | 123.0 | 3 | 124.3 | |
| 14 | 1 | 118.0 | - | - | 1 | 118.0 | |
| 15 | - | - | 2 | 124.5 | 2 | 124.5 | |
| 16 | 5 | 128.0 | 1 | 126.0 | 6 | 127.7 | 5.9 |
| Total | 41 | | 26 | | 67 | | |

Table C-10.--Monthly mean weights of pregnant fur seals collected pelagically by the United States off Washington in 1967

| Age | January | | February | | January-February | | |
|---|---|---|---|---|---|---|---|
| | Seals | Mean weight | Seals | Mean weight | Seals | Mean weight | Standard deviation |
| Years | Number | Kg. | Number | Kg. | Number | Kg. | Kg. |
| 5 | 2 | 26.5 | 2 | 27.5 | 4 | 27.0 | |
| 6 | 8 | 30.2 | 4 | 29.7 | 12 | 30.1 | 3.2 |
| 7 | 1 | 37.0 | 4 | 34.7 | 5 | 35.2 | 4.5 |
| 8 | 3 | 33.0 | 3 | 36.3 | 6 | 34.7 | 3.0 |
| 9 | 10 | 35.7 | 2 | 37.5 | 12 | 36.0 | 4.6 |
| 10 | 5 | 37.2 | 5 | 36.6 | 10 | 36.9 | 2.9 |
| 11 | 3 | 35.3 | 1 | 39.0 | 4 | 36.2 | |
| 12 | 1 | 37.0 | 1 | 45.0 | 2 | 41.0 | |
| 13 | 2 | 41.0 | 1 | 40.0 | 3 | 40.7 | |
| 14 | 1 | 34.0 | - | - | 1 | 34.0 | |
| 15 | - | - | 2 | 37.0 | 2 | 37.0 | |
| 16 | 5 | 42.4 | 1 | 39.0 | 6 | 41.8 | 4.6 |
| Total | 41 | | 26 | | 67 | | |

Table C-11.--Monthly mean lengths of nonpregnant female seals collected pelagically by the United States off Washington in 1967

| Age | January | | February | | January-February | | |
|---|---|---|---|---|---|---|---|
| | Seals | Mean length | Seals | Mean length | Seals | Mean length | Standard deviation |
| Years | Number | Cm. | Number | Cm. | Number | Cm. | Cm. |
| 1 | 3 | 72.7 | 3 | 71.7 | 6 | 72.2 | 3.4 |
| 2 | 2 | 82.5 | 1 | 79.0 | 3 | 81.3 | |
| 3 | 4 | 99.5 | 6 | 97.0 | 10 | 98.0 | 4.4 |
| 4 | 5 | 110.4 | 4 | 112.0 | 9 | 111.1 | 5.4 |
| 5 | 4 | 114.7 | 1 | 118.0 | 5 | 115.4 | 2.7 |
| 6 | 6 | 117.2 | 2 | 123.0 | 8 | 118.6 | 5.7 |
| 7 | 2 | 121.0 | - | - | 2 | 121.0 | |
| 8 | 1 | 120.0 | - | - | 1 | 120.0 | |
| 10 | 1 | 131.0 | - | - | 1 | 131.0 | |
| 12 | 1 | 129.0 | - | - | 1 | 129.0 | |
| 15 | 1 | 132.0 | - | - | 1 | 132.0 | |
| 17 | 2 | 127.0 | - | - | 2 | 127.0 | |
| 20 | - | - | 1 | 133.0 | 1 | 133.0 | |
| 22 | - | - | 1 | 130.0 | 1 | 130.0 | |
| Total | 32 | | 19 | | 51 | | |

Table C-12.--Monthly mean weights of nonpregnant female seals collected pelagically by the United States off Washington in 1967

| Age | January | | February | | January-February | | |
|---|---|---|---|---|---|---|---|
| | Seals | Mean weight | Seals | Mean weight | Seals | Mean weight | Standard deviation |
| Years | Number | Kg. | Number | Kg. | Number | Kg. | Kg. |
| 1 | 3 | 6.8 | 3 | 7.0 | 6 | 6.9 | 0.2 |
| 2 | 2 | 10.2 | 1 | 10.5 | 3 | 10.3 | |
| 3 | 4 | 17.0 | 6 | 16.0 | 10 | 16.4 | 2.7 |
| 4 | 5 | 22.4 | 4 | 25.0 | 9 | 23.6 | 2.1 |
| 5 | 4 | 27.2 | 1 | 28.0 | 5 | 27.4 | 3.3 |
| 6 | 6 | 28.3 | 2 | 31.0 | 8 | 29.0 | 3.7 |
| 7 | 2 | 28.5 | - | - | 2 | 28.5 | |
| 8 | 1 | 30.0 | - | - | 1 | 30.0 | |
| 10 | 1 | 40.0 | - | - | 1 | 40.0 | |
| 12 | 1 | 38.0 | - | - | 1 | 38.0 | |
| 15 | 1 | 36.0 | - | - | 1 | 36.0 | |
| 17 | 2 | 39.5 | - | - | 2 | 39.5 | |
| 20 | - | - | 1 | 53.0 | 1 | 53.0 | |
| 22 | - | - | 1 | 47.0 | 1 | 47.0 | |
| Total | 32 | | 19 | | 51 | | |

Table C-13.--Monthly mean lengths of male seals collected pelagically by the United States off Washington in 1967

| Age | January | | February | | January-February | | |
|---|---|---|---|---|---|---|---|
| | Seals | Mean length | Seals | Mean length | Seals | Mean length | Standard deviation |
| Years | Number | Cm. | Number | Cm. | Number | Cm. | Cm. |
| 1 | 2 | 74.0 | 4 | 77.7 | 6 | 76.5 | 5.2 |
| 2 | 3 | 96.3 | 2 | 93.5 | 5 | 95.2 | 1.9 |
| 3 | 1 | 105.0 | - | - | 1 | 105.0 | |
| 4 | 1 | 110.0 | - | - | 1 | 110.0 | |
| Total | 7 | | 6 | | 13 | | |

Table C-14.--Monthly mean weights of male seals collected pelagically by the United States off Washington in 1967

| Age | January | | February | | January-February | | |
|---|---|---|---|---|---|---|---|
| | Seals | Mean weight | Seals | Mean weight | Seals | Mean weight | Standard deviation |
| Years | Number | Kg. | Number | Kg. | Number | Kg. | Kg. |
| 1 | 2 | 8.5 | 4 | 8.6 | 6 | 8.6 | 1.6 |
| 2 | 3 | 16.2 | 2 | 14.5 | 5 | 15.5 | 1.3 |
| 3 | 1 | 22.0 | - | - | 1 | 22.0 | |
| 4 | 1 | 19.0 | - | - | 1 | 19.0 | |
| Total | 7 | | 6 | | 13 | | |

Table C-15.--Monthly mean lengths and weights of fur seal fetuses collected pelagically by the United States off Washington in 1967

| Period | Male | | | Female | | |
|---|---|---|---|---|---|---|
| | Fetuses | Mean length | Mean weight | Fetuses | Mean length | Mean weight |
| | Number | Cm. | Kg. | Number | Cm. | Kg. |
| 1-10 Jan. | 4 | 13.1 | 0.1 | 1 | 17.0 | 0.1 |
| 11-20 " | 10 | 15.7 | 0.1 | 11 | 16.0 | 0.1 |
| 21-30 " | 6 | 22.2 | 0.3 | 9 | 21.4 | 0.3 |
| 1-10 Feb. | 8 | 24.3 | 0.4 | 16 | 23.8 | 0.4 |
| 11-20 " | - | - | - | 1 | 27.5 | 0.6 |
| Total | 28 | | | 38 | | |

Table C-16.--Reproductive condition of female seals collected pelagically by the United States off Washington in 1967

| Age | Nulliparous | Primiparous | | | Multiparous | | | Total |
|---|---|---|---|---|---|---|---|---|
| | | Nonpregnant | Pregnant | | Nonpregnant | Pregnant | | |
| Years | Number | Number | Number | Percent | Number | Number | Percent | Number |
| | | | | January | | | | |
| 1 | 3 | - | - | - | - | - | - | 3 |
| 2 | 2 | - | - | - | - | - | - | 2 |
| 3 | 4 | - | - | - | - | - | - | 4 |
| 4 | 5 | - | - | - | - | - | - | 5 |
| 5 | 4 | - | 1 | 100.0 | - | 1 | 100.0 | 6 |
| 6 | 6 | - | 2 | 100.0 | - | 6 | 100.0 | 14 |
| 7 | - | 1 | - | - | 1 | 1 | 50.0 | 3 |
| 8 | - | 1 | - | - | - | 3 | 100.0 | 4 |
| 9 | - | - | - | - | - | 10 | 100.0 | 10 |
| 10 | - | - | - | - | 1 | 5 | 83.3 | 6 |
| 11 | - | - | - | - | - | 3 | 100.0 | 3 |
| 12 | - | - | - | - | 1 | 1 | 50.0 | 2 |
| 13 | - | - | - | - | - | 2 | 100.0 | 2 |
| 14 | - | - | - | - | - | 1 | 100.0 | 1 |
| 15 | - | - | - | - | 1 | - | - | 1 |
| 16 | - | - | - | - | - | 5 | 100.0 | 5 |
| 17 | - | - | - | - | 2 | - | - | 2 |
| Total | 24 | 2 | 3 | | 6 | 38 | | 73 |
| Percent | | | | 60.0 | | | 86.4 | |
| | | | | February | | | | |
| 1 | 3 | - | - | - | - | - | - | 3 |
| 2 | 1 | - | - | - | - | - | - | 1 |
| 3 | 6 | - | - | - | - | - | - | 6 |
| 4 | 4 | - | - | - | - | - | - | 4 |
| 5 | 1 | - | 2 | 100.0 | - | - | - | 3 |
| 6 | 1 | 1 | - | - | - | 4 | 100.0 | 6 |
| 7 | - | - | - | - | - | 4 | 100.0 | 4 |
| 8 | - | - | - | - | - | 3 | 100.0 | 3 |
| 9 | - | - | - | - | - | 2 | 100.0 | 2 |
| 10 | - | - | - | - | - | 5 | 100.0 | 5 |
| 11 | - | - | - | - | - | 1 | 100.0 | 1 |
| 12 | - | - | - | - | - | 1 | 100.0 | 1 |
| 13 | - | - | - | - | - | 1 | 100.0 | 1 |
| 15 | - | - | - | - | -- | 2 | 100.0 | 2 |
| 16 | - | - | - | - | - | 1 | 100.0 | 1 |
| 20 | - | - | - | - | 1 | - | - | 1 |
| 22 | - | - | - | - | 1 | - | - | 1 |
| Total | 16 | 1 | 2 | | 2 | 24 | | 45 |
| Percent | | | | 66.7 | | | 92.3 | |

Table C-17.--Pregnancy rates of female seals collected pelagically by the United States off Washington, by month, in 1967

| Age | January | | | February | | | Combined data | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Wash. 1967 | 1958-67 pelagic collections |
| | Seals | Pregnant | | Seals | Pregnant | | Pregnant | Pregnant |
| | Number | Number | Percent | Number | Number | Percent | Percent | Percent |
| 3 | 4 | 0 | 0 | 6 | 0 | 0 | 0 | 0.4 |
| 4 | 5 | 0 | 0 | 4 | 0 | 0 | 0 | 3.1 |
| 5 | 6 | 2 | 33.3 | 3 | 2 | 66.7 | 44.4 | 38.5 |
| 6 | 14 | 8 | 57.1 | 6 | 4 | 66.7 | 60.0 | 72.7 |
| 7 | 3 | 1 | 33.3 | 4 | 4 | 100.0 | 71.4 | 81.1 |
| 8 | 4 | 3 | 75.0 | 3 | 3 | 100.0 | 85.7 | 86.9 |
| 9 | 10 | 10 | 100.0 | 2 | 2 | 100.0 | 100.0 | 90.3 |
| 10 | 6 | 5 | 83.3 | 5 | 5 | 100.0 | 90.9 | 89.8 |
| 11 | 3 | 3 | 100.0 | 1 | 1 | 100.0 | 100.0 | 90.1 |
| 12 | 2 | 1 | 50.0 | 1 | 1 | 100.0 | 66.7 | 88.2 |
| 13 | 2 | 2 | 100.0 | 1 | 1 | 100.0 | 100.0 | 87.7 |
| 14 | 1 | 1 | 100.0 | - | - | - | 100.0 | 83.5 |
| 15 | 1 | 0 | 0 | 2 | 2 | 100.0 | 66.7 | 81.8 |
| 16 | 5 | 5 | 100.0 | 1 | 1 | 100.0 | 100.0 | 79.1 |
| 17 | 2 | 0 | 0 | - | - | - | - | 67.5 |
| 18 | - | - | - | - | - | - | - | 68.5 |
| 19 | - | - | - | - | - | - | - | 54.9 |
| 20 | - | - | - | 1 | 0 | 0 | 0 | 45.6 |
| 21 | - | - | - | - | - | - | - | 64.0 |
| 22 | - | - | - | 1 | 0 | 0 | 0 | 40.0 |

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